HONI SOIT QUI MAL Y PE

16766.

S.
24-11-06
1661

Hugh, Duke of Northumberland

F.R.S. F.S.A. &c.

Late one of the Vice-Presidents of the Society

for the Encouragement of Arts, Manufactures & Commerce.

Engraved by Chas. Warren, from a Portrait by Thos. Phillips, R.A.

in the Possession of the Earl of Egremont.

16766

# TRANSACTIONS

OF THE

# SOCIETY,

Instituted at London,

FOR THE

# ENCOURAGEMENT

OF

# ARTS, MANUFACTURES, AND COMMERCE;

WITH THE

*PREMIUMS OFFERED IN THE YEAR* 1818.

## VOL. XXXVI.

*LONDON:*

SOLD BY THE HOUSEKEEPER, AT THE SOCIETY'S HOUSE IN THE ADELPHI;

AND BY ALL BOOKSELLERS.

[*Price Ten Shillings and Sixpence.*]

MDCCCXIX.

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HISTORICAL
MEDICAL
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# PREFACE.

THE present Volume, prepared, as customary, under the inspection of the Committee of Correspondence and Papers, contains the particulars of those meritorious exertions which have been rewarded by Medals or Pecuniary Gratifications during the last Session. The number of subjects is not, perhaps, so great as on some former occasions, but it is hoped that both the Society and the Public will be of opinion that the value of the Communications amply makes up for any deficiency in the former respect.

In the Class of Agriculture the Society has conferred two Medals, being the Premiums offered for the successful Plantation of Forest Trees on Land not adapted to other Cultivation. Sir W. W. Wynne, Bart., received the first Medal for 206 acres of Plantation; and Ralph Creyke, Esq., the second Medal, for 34 acres. The Rev. Dr. Cartwright has been the success-

ful claimant for the Honorary Premium offered for Comparative Experiments on the Efficacy of different Manures, his attention being specially directed to the action of Burnt Clay, as a top dressing on stiff soils. The spirited and judicious process by which Robert Haldane Bradshaw, Esq., M. P., has reclaimed nearly 300 acres of Peat Moss, and thus opened a new source of supply to the markets of the populous district in which his improvements are situated, demanded, and has received, the Gold Medal of the Society. A Medal, and a pecuniary Reward, have been awarded to Mr. Common, for his ingenious Self-Adjusting Double Drill Turnip Sower. A branch of rural economy, interesting from its connexion with the instincts and manners of one of the most curious of the insect tribe, and valuable from the resources which it offers to the cottager, as well as to the other inhabitants of the country, has been well illustrated by I. Espinasse, Esq.; his Communication on the Management of Bees, being the result of assiduous and long continued personal observation, may be securely confided in.

In the Class of Chemistry, the Gold Medal

has been awarded to A. Bowden, Esq., of the Navy Office, in consequence of the success which has hitherto attended the temporary submersion of ships in sea-water, as a means of preventing and curing the Dry Rot. This method was suggested in a work on the subject, published by Mr. Bowden in the year 1815; and, by order of the Lords of the Admiralty, was made trial of on the Eden sloop of war, in the Autumn of the following year.

Under particular circumstances, the Society of Arts extends its bounty even to posthumous merit, and hence has rewarded, during the last Session, the widow of the late Samuel Brierly, for a simple and effectual machine, invented by him, for stretching Woollen Warps.

To diminish, as much as possible, the necessary and accidental hazard of life and of limb, to which certain indispensable employments are particularly exposed, has ever been an important object in the views of the Society. Mr. Grant's Life Preserver, in cases of shipwreck, particularly adapted to the merchant service; Mr. Cook's Night Life Buoy, chiefly for the use

of the navy; and Mr. Prior's method of providing against the fatal accidents that are perpetually occurring in Mines, in consequence of the breaking of the rope by which the men ascend and descend, evince the undiminished zeal of the Society in the service of humanity. Mr. Ramshaw's improvements in Copper-plate Printing might be cited as another example in this class, if they did not, at the same time, claim the additional merit of improving the quality of the produce.

To Mr. Park, the inventor of the New Mooring Blocks, adopted, by order of the Navy Board, in Portsmouth Harbour, the Society has most gladly awarded a Gold Medal. In cheapness, in security, in precluding the necessity of throwing many thousand tons of shingle into a harbour already too shallow, this invention possesses as many substantial claims to public notice, and we doubt not will come into general use.

Mr. Ritchie's improvement in Time-keepers, by locking together the pallets, crutch, and pendulum, occasions a great saving in the motive force, and obviates a very powerful cause of the

inequality in the rate of going. It is simple, cheap, and may be adapted to all extant clocks, and, therefore, the Society have conferred upon the inventor, both a Medal and a Pecuniary Reward.

Lieutenant Shuldham's very ingenious plan of Ballasting Sailing Boats, Dispatch Vessels, &c., so as to accommodate the center of gravity to the particular state of the wind and sea, having, on trial, been found to be considerably successful, has obtained the favourable notice of the Society; and is here published, in order to encourage and suggest farther experiments.

Mr. Jones's arrangement of the Sheaves of Pulley Blocks is calculated to improve, at the same time, the power and the simplicity of this very extensively useful machine.

Mr. Clement's Machine for drawing Circles, Ellipses, and Right Lines on Paper, or on Copper, by which ellipses of all proportions may be geometrically described, will probably be considered as second in importance and ingenuity to none of the preceding communications. The

opinion entertained of it by the Society may be judged of, from their having conferred on the inventor the Gold Medal, and from their having appropriated to its full illustration a very unusual number of engravings. For one of those which are in outline, the Society is indebted to the liberality of R. H. Solly, Esq., a Chairman of the Committee of Polite Arts; the others in outline are presented by Mr. Clement.

The Portrait of the late Duke of Northumberland, prefixed to the present Volume, is offered as a mark of respect to the noble House of Percy, the members of which, from the very commencement of the Institution, by liberal subscriptions, and, what is more gratifying, by personal attention, have ever shown themselves the zealous friends of the Society, "Simili frondescit virga metallo."

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The Society take the present opportunity of returning their Thanks to the different Public Bodies and Individuals who have honoured them with Presents during the Session, the particulars of which are noticed in the body of the Volume. Without presuming to direct in what channels the liberality of the friends to this Institution shall flow, it may be stated, that such contributions as may put the Society in possession of a compleat collection of all the Publications of any value on the application of Mathematics to practical Mechanics, will be especially acceptable.

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*The Society desire it to be clearly understood, that, as a Body, they are not responsible for any Opinion or Representation of Facts contained in the following Pages.*

*The Society having determined to print the result of their Investigations on the Means of Preventing the Forgery of Bank Notes in a separate Volume, royal 8vo., the same will be delivered to the Members, together with this Volume. The price to the Public is 4s. in boards.*

# SOCIETY

FOR THE

# ENCOURAGEMENT

OF

# ARTS,

# MANUFACTURES,

AND

# COMMERCE.

## Premiums offered

IN THE SESSION 1818—1819.

*LONDON:*

PRINTED BY ORDER OF THE SOCIETY

*FOR GRATUITOUS DISTRIBUTION,*

AND MAY BE HAD, BY APPLICATION, AT THEIR HOUSE IN THE ADELPHI.

Printed by T. C. HANSARD (by his Patent Improved Double Press), Peterborough-court, Fleet-street.

*June* 1818.

*A LIST of the Officers of the* SOCIETY, *and Chairmen of the several Committees.*

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*Housekeeper,* MISS A. B. COCKINGS.
*Collector,*

# *ADVERTISEMENT TO THE PUBLIC.*

THE chief object of the Society is, to promote the Arts, Manufactures and Commerce of this Kingdom, by giving honorary or pecuniary Rewards, as may be best adapted to the case, for all such useful Inventions, Discoveries, and Improvements (though not mentioned in this advertisement) as tend to that purpose; and, in pursuance of this plan, the Society have already expended upwards of Eighty five Thousand Pounds, advanced by voluntary subscriptions of Members, and legacies bequeathed.

The Register of Premiums and Bounties which they have given, and which may be seen at the Society's house in the Adelphi, will show the very great advantages derived by the Public from this Institution.

The meetings of the Society are held every Wednesday, at seven o'clock in the evening, from the first Wednesday in November to the second Wednesday in June. The several Committees meet on other evenings in the week during the session, as particularly mentioned in their printed book of Rules and Orders.

In order still farther to promote the laudable Views of the Society, it may be necessary to explain the mode by which members are elected.

Each member has the privilege, at an ordinary meeting of the Society, or by letter to the Secretary, to propose any person who is desirous to become a Member; such proposal to contain the name, full addition, and place of abode, of the proposed Member, and to be signed by three members of the Society.

Peers of the Realm or Lords of Parliament are, on their being proposed, immediately balloted for; the names of other persons proposed to become Members are read by the Secretary at the next meeting of the Society, and are then inserted in lists which are hung up in the Society's room; they are balloted for at the second following ordinary meeting. In both cases, if two-thirds of the Members then voting ballot in their favour, they are deemed Perpetual Members upon payment of not less than Twenty Guineas in one sum, or Subscribing Members upon payment of any sum not less than Two Guineas annually.

All Members are entitled to vote and assist in all the business of the Society and of the several Committees. The Members have also the privilege of recommending two persons as auditors at the meetings of the Society; and, by addressing a note to the housekeeper, of introducing their friends on any week day, except Wednesday, between the hours of ten and two, to examine the various Models, Machines, and Productions, in different branches of Arts, Manufactures, and Commerce, for which rewards have been bestowed; also to inspect the magnificent series of Moral and Historical Paintings, executed by the late J. Barry, Esq. which, with some valuable Busts, Statues, Portraits, &c. decorate the public rooms of the Society.

Members have the use of the Society's Library, which is valuable and annually increasing by the purchase and donation of scientific and useful books and of engravings. The Society are highly sensible of the great importance of such acquisitions, and are happy to record them, with the names of the donors, in the Volume annually published of the Society's Transactions, to which the Members are entitled.

Ladies are eligible, as Members of the Society, to all the Privileges thereof, and alone are entitled to vote by proxy at elections, through the medium of any gentleman who is a Member, on his producing a written authority for the same.

The Society desire it to be clearly understood, that, as a Body, they are not responsible for any opinion or representation of Facts contained in their Volumes. And the Public are requested to guard against impositions, from persons advertising as having Patents for Articles rewarded by the Society. It is a stipulated condition, that all Persons who receive Premiums or Bounties from the Society, shall

relinquish all Pretensions to a Patent for Articles so rewarded, and shall allow them to be made or manufactured by any Person whatever.—The Public are also cautioned against purchasing Articles sold under a pretended sanction of the Society's Name.

The consideration of the Claims to the Premiums offered in the present List, will take place during the Session of the Society, commencing on Wednesday, the 4th of November, 1818. The several Candidates and Claimants, to whom the Society shall adjudge Premiums or Bounties, are to attend, as required by the Secretary, on the last Tuesday in May, at eleven o'clock in the forenoon precisely, to receive the same; that Day being appointed by the Society for the Distribution of their Rewards; and before that time no Premium or Bounty will be delivered, except to those who are about to leave the Kingdom.

In cases where the Society may think fit to admit excuses for not attending in person, Deputies may be substituted to receive the Rewards, provided such Deputies are either Members of the Society, or superior Officers thereof.

Since the last Distribution of Rewards, *Two Hundred* New Members have been elected.

The Society have lately published, the 35th *Volume* of their Transactions, to which all Members are entitled; and which others may purchase from the House-keeper, price 10*s.* 6*d.* boards. Also complete Sets of their Transactions, or any former Volume.

Also, An *Analytical Index of the First twenty-five Volumes* of the Transactions, to the termination of the Session, June, 1807, price 2*s.* 6*d.* With a list of the Machines and Models in the Society's Repository, to the year 1813, inclusive.

A Catalogue of Books in the Society's Library, may be procured as above, price 1*s.* with an Appendix thereto.

## *GENERAL CONDITIONS.*

AS the great object of the Society in rewarding individuals is, to draw forth and give currency to those inventions and improvements which are likely to benefit the public at large, Candidates are requested to observe, that if the means by which the respective objects are effected, require an expense or trouble too great for general purposes, the Society will not consider itself bound to give the offered reward; but, though it thus reserves the power of giving in all cases such part only of any premium as the performance shall be adjudged to deserve, or of withholding the whole if there be no merit, yet the Candidates may be assured the Society will always judge liberally of their several claims.

All Candidates are to take notice, that no claim for a premium will be attended to, unless the conditions are fully complied with.

The models of all machines, which obtain premiums or bounties, shall be the property of the Society.—The Premiums are designed for the United Kingdom, unless expressly mentioned to the contrary.—The claims will be determined as soon as possible after the delivery of the specimens.—It is expected that all articles for claims or bounties be sent to the Society, carriage paid.

No person shall receive any premium, bounty, or encouragement, from the Society, for any matter for which he has obtained or purposes to obtain, a patent, or for which he has obtained any premium or reward from any other Society.

A Candidate for a premium, or a person applying for a bounty, being detected in any disingenuous method to impose on the Society, shall forfeit such premium or bounty, and be deemed incapable of obtaining any for the future.

No member of this Society shall be a Candidate for, or entitled to receive, any premium, bounty, or reward whatsoever, except the honorary medal of the Society. The Candidates are, in all cases, expected to furnish a particular account of the subject of their claims; and where certificates are required to be produced in claim of premiums, they should be expressed, as nearly as possible, in the words of the respective advertisement, and be signed by disinterested persons who have a positive knowledge of the facts stated.

Where premiums or bounties are obtained in consequence of specimens produced, the Society mean to retain such part of those specimens as they may judge necessary, making a reasonable allowance for the same.

No Candidate, not a member, shall be present at any meeting of the Society or Committees, or admitted at the Society's rooms, after they have delivered in their claims, until such claims are adjudged, unless summoned by the Committee.

The Society, anxious to promote the Arts of their country, have adopted the resolution of forming a Collection of Prints, to be open for public inspection; and, having arranged those already in their possession, invite engravers to send etched or finished proofs of their plates; and hope that amateurs, collectors, and publishers of works of art, will also contribute to the undertaking.

Prints of machines, or maps, will also come within this arrangement.

This Society farther invite the communications of scientific and practical men, upon all subjects connected with the views of this Society, although their experiments may have been conducted upon a smaller scale than the terms required by the premiums; as such communications may afford ground for more extensive application, and thus materially contribute to the advantage of the public.

The Library of the Society, which has already become very valuable, may yet receive considerable additions and improvements from the presents of members, or other persons who may be inclined to place useful books or valuable manuscripts in a repository at once permanent and conducive to the national benefit.

All communications are to be made by letter, addressed to Arthur Aikin, Esq. the Secretary, at the Society of Arts, &c. Adelphi, London.

And where articles are sent by Sea for the Society, the Bills of Lading are to be addressed to the care of William Vaughan, Esq. Mincing-lane, London, who has undertaken to receive them for the Society.

The Winchester bushel is the measure referred to for grain; and, as the acres of different districts vary in extent, it is necessary to observe, that the Society mean Statute Acres of five and a half yards to the rod or pole, and they request that all communications to them may be made agreeably thereto.

The Society desire that the Papers on different subjects sent to them may be full, clear, and explicit, fit for publication; and that descriptive Drawings may be sent, with the Models and Machines laid before the Society.

*** To persons inclined to leave a sum of money to this Society by Will, the following form is offered for that purpose.

*Item. I give and bequeath to A. B. and C. D. the sum of*
*upon condition and to the intent that they, or one of them, do pay the same to the Collector, for the time being, of a Society in London, who now call themselves the Society for the Encouragement of Arts, Manufactures, and Commerce; which said sum of*
*I will and desire may be paid out of my personal estate, and applied towards the carrying on the laudable designs of the Society.*

The Society take this opportunity of returning their thanks to the several Societies and Individuals who have favoured them with Presents for their Repository and Library.

# *PREMIUMS IN AGRICULTURE.*

THE Candidates for planting all kinds of Trees are to mention the nature of the Soil, to produce Certificates that the respective Plantations are properly fenced and secured, and particularly to state the condition of the Plants at the time of sending such Certificates. Any information which the Candidates for the following Premiums may choose to communicate, relative to the methods made use of in forming the Plantations, or promoting the growth of the several Trees, or any other observations that may have occurred on the subject, will be thankfully received.

It is the intention of the Society that such lands only as are not calculated for the purposes of husbandry, should be employed for the purposes specified in these Advertisements relative to Plantations.

## ACORNS.

1. FOR having set between the first of October, 1816, and the first of April, 1817, the greatest quantity of land, not less than ten acres, with Acorns, with or without seeds, cuttings, or plants of other trees, at the option of the candidate; and for effectually fencing and preserving the same, in order to raise timber;—*the Gold Medal.*

2. For the second greatest quantity of land, not less than five acres, set agreeably to the above conditions;—*the Silver Medal.*

Certificates of setting agreeably to the above conditions, and that there are not fewer than three hundred young Oaks on each acre, to be delivered to the Society on or before the first Tuesday in February, 1819.

## RAISING OAKS.

3. To the person who shall have raised, since the year 1814, the greatest number of Oaks, not fewer than five thousand, either from young plants or acorns, in order to secure a succession of oak timber in this kingdom;—*the Gold Medal.*

4. For the next greatest number, not fewer than three thousand;—*the Silver Medal.*

Certificates that there were on the land at least the number of young Oak Trees required, in a thriving condition, two years after the planting, with an account of the methods pursued in making and managing the plantation, to be produced to the Society on or before the first Tuesday in February, 1819.

## THE BEST METHOD OF RAISING OAKS.

5. To the person who shall ascertain in the best manner by actual experiments, the comparative merits of the different modes of raising Oaks for timber, either from acorns set on land properly dug or tilled, from acorns set by the spade or dibble, without digging or tillage, either on a smooth surface, or among bushes, fern, or other cover; or from young plants previously raised in nurseries, and transplanted; regard being had to the expense, growth, and other respective advantages of the several methods;—*the Gold Medal.*

The accounts and proper certificates that not less than one acre has been cultivated in each mode, to be produced to the Society on or before the first Tuesday in February, 1819.

## ELM.

6. For having planted the greatest number of the English Elm, not less than eight thousand, between the 24th of June, 1816, and the 24th of June, 1817, and for having effectually fenced and preserved the same, in order to raise timber;—*the Gold Medal.*

7. For the second greatest number, not less than five thousand;—*the Silver Medal.*

Certificates of having planted agreeably to the above conditions, that the plants were in a healthy and thriving state two years at least after making the plantation, and specifying the distance of the plants, to be delivered to the Society on or before the first Tuesday in April, 1819.

### LARCH.

8. For having planted out, between the 24th of June, 1815, and the 24th of June, 1816, the greatest number of Larch Trees, not fewer than five thousand, and for having effectually fenced and preserved the same, in order to raise timber;—*the Gold Medal.*

9. For the next greatest number, not fewer than three thousand;—*the Silver Medal.*

Certificates of the number of plants, that they were in a healthy and thriving state two years at least after they were planted out, with a general account of the methods used in making the plantation, to be delivered to the Society on or before the last Tuesday in January, 1819.

*N. B.* The Larch Trees may be planted either mixed with other trees, or by themselves, as may best suit the convenience of the planter.

### ASH.

10. For having sown or set, in the year 1815, the greatest quantity of land, not less than six acres, with Ash for timber, with or without seeds, cuttings, or plants, of such other trees as are adapted to the soil;—*the Gold Medal.*

11. For the next greatest quantity, not less than four acres;—*the Silver Medal.*

Certificates of the sowing or setting, agreeably to the above conditions, that there are not fewer than six hundred Ash Plants on each acre, in a thriving and healthy condition, two years at least after the sowing or setting, with a general account of the methods used in making the plantation, to be delivered to the Society on or before the last Tuesday in January, 1819.

### FOREST TREES.

12. To the person who shall have enclosed and planted, or set, the greatest number of acres (not less than ten) of land that is incapable of being ploughed, such as the borders of rivers, the sides of precipices, and any land that has too many rocks, or that is not calculated to repay the expense of tillage, owing to the surface being too hilly, mountainous, or otherwise unfit for tillage, with the best sorts of Forest Trees, namely, oak, Spanish chesnuts, ash, elm, beech, alder, willow, larch, spruce, and silver fir (with or without screens of Scotch fir adapted to the soil,) and intended for timber trees, between the first of Oct. 1815, and the first of April, 1816;—*the Gold Medal.*

13. For the second greatest quantity of land; not less than seven acres;—*the Silver Medal.*

A particular account of the methods used in making and managing the plantations, the nature of the soil, the probable number of each sort of plants, together with proper certificates that they were in a healthy and thriving state two years at least after making the plantations, to be delivered to the Society on or before the second Tuesday in January, 1819.

*N. B.* With the above Forest Trees, the seeds, cuttings, or plants, of such other trees as are adapted to the soil, and proper for underwood, may or may not be intermixed.

### NORWAY FIR SEEDLINGS.

14. To the person who shall have planted in the united kingdom, during the year 1816, the greatest number, not less than two thousand, of red wood and white wood Norway Fir Seedlings, at sufficient distances from each other to stand for timber trees;—*the Gold Medal.*

Certificates of the number of plants, that they were in a thriving state two years at least after they were planted out, with a general account of the methods used in making the plantation, to be delivered to the Society on or before the first Tuesday in January, 1819.

*N. B.* It is recommended to plant the seedlings of about three or four years growth, and in a moderately good soil, somewhat sheltered; the wood from the district of Christiana is esteemed the best for carpenters' and joiners' use and for spars and upers the trees near to Long Sound are most valued.

CHESNUTS.

15. For having sown or set between the 1st of October, 1816, and the 1st of April, 1817, the greatest quantity of land, not less than six acres, with Spanish Chesnuts, with or without seeds, cuttings, or plants of other trees, adapted to such soil, at the option of the candidate; and for effectually fencing and preserving the same, in order to raise timber;—*the Gold Medal.*

16. For the second greatest quantity, not less than four acres;—*the Silver Medal.*

Certificates of sowing or setting, agreeably to the above conditions, and that there are not fewer than three hundred Chesnut Plants in a thriving state, on each acre, to be delivered to the Society on or before the first Tuesday in February, 1819.

WALNUT TREES.

17. For having planted the greatest number of Walnut Trees, not less than five hundred, between the 24th of June, 1816, and the 24th of June, 1817, and for having effectually fenced and preserved the same, in order to raise timber;—*the Gold Medal.*

18. For the next greatest number, not fewer than three hundred;—*the Silver Medal.*

Certificates of having planted agreeably to the above conditions, and that the plants were in a healthy and thriving state two years at least after making the plantations, and specifying the distance of the plants from each other, to be delivered to the Society on or before the first Tuesday in April, 1819.

WALNUTS.

19. To the person who shall invent and discover to the Society an improved mode of propagating the superior varieties of Walnuts, either by budding, grafting, or any other mode, except sowing;—*the Gold Medal.*

Certificates that not less than fifty trees have been so raised, in the year 1817, with a full account of the method practised, to be produced to the Society on or before the first Tuesday in April, 1819.

SECURING PLANTATIONS.

20. To the person who shall give to the Society the most satisfactory account, founded on experience, of the most effectual and least expensive method of securing Young Plantations of timber trees and hedge rows, from hares and rabbits, as well as from sheep and large cattle, which at the same time shall be least subject to the depredations of wood-stealers;——*the Silver Medal.*

The accounts, and certificates of the efficacy of the method, to be produced to the Society on or before the last Tuesday in December, 1819.

WHEAT.

21. For the best set of experiments made on not less than twelve acres, four of which to be sown broad-cast, four drilled, and four dibbled, the two latter in equi-distant rows, in order fully to ascertain which is the most advantageous mode of cultivating wheat;—*the Gold Medal.*

It is required that every operation and expense of each mode of culture be fully described; and that proper certificates of the nature and condition of the land on which the experiments were made, together with an account of the produce of the corn, the weight per bushel, and also of the straw, be produced to the Society on or before the first Tuesday in February, 1819.

BEANS.

22. To the person who shall discover and cultivate, either by the drill or dibbling method, on not less than five acres, a species of Horse-beans or Tick-beans, that will ripen their seeds before the 21st of August;—*the Silver Medal.*

It is required that a particular account of the bean, the cultivation, and the expense attending it, with proper certificates of the nature and condition of the land on which the experiments were made, together with an account of the produce, the weight per Winchester bushel, and a sample of not less than a peck, be produced to the Society on or before the first Tuesday in February, 1819. It is apprehended that if a Bean should be brought into cultivation with the habits of hotspur, or other early peas, it would in a great measure escape the danger arising from the collier insect, or other insects, and allow more time for the farmers to till the land for the subsequent crop of wheat.

PARSNIPS.

23. To the person who shall cultivate the greatest quantity of land, not less than five acres, with Parsnips, for the particular purpose of feeding cattle or sheep;—*the Gold Medal.*

Certificates of the quantity of land so cultivated, with a particular account of the nature of the soil and weight of the produce on sixteen perches, and also of the condition of the cattle or sheep fed with the Parsnips, and the advantages resulting from the practice, to be produced to the Society on or before the second Tuesday in Feb. 1819.

BUCK WHEAT.

24. To the person who shall cultivate the greatest quantity of land with Buck Wheat, not less than thirty acres;—*the Gold Medal.*

It is required that the time of sowing and reaping be noticed; also a particular account of the species, cultivation, and expense attending it, the manner of reaping it, thrashing it, and housing the grain; with proper certificates of the nature and condition of the land on which the experiments were made, and the name of the crop, if any, which the same land bore the preceding year, together with an account of the produce, and a sample of the seed, not less than a quart, be produced to the Society on or before the second Tuesday in Jan. 1819.

25. For the next greatest quantity, not less than fifteen acres, on similar conditions;—*the Silver Medal.*

Information respecting its application to the feeding of cattle, hogs, and poultry, and other of its uses, is also desired. It is known to be particularly serviceable in furnishing honey to bees.

GRASS SEEDS.

26. To the persons who shall raise the greatest quantity of each or any of the following named grass seeds, viz.—Meadow Fox-tail (alopecurus pratensis), Sweet-scented Vernal-grass (anthoxanthum odoratum), Timothy-grass (phleum pratense), Meadow Fescue-grass (festuca pratensis), smooth-stalked Meadow-grass (poa pratensis), rough-stalked Meadow-grass (poa trivialis;) rough Cock's-foot (dactylis glomerata) perennial Ray-grass (lollium perenne);—*the Siver Medal.*

It is required that certificates from persons who have viewed them in a proper state to identify that they are one or other of the seeds above-mentioned, indicating clearly the particular species, and noticing the quantity produced of such seeds, free from weeds or mixture of other grasses, together with proper samples of the seeds, be produced to the Society on or before the first day of February, 1819.

HEMP.

27. The Society, wishing to encourage the growth of Hemp for the use of the navy in every part of the united Empire, offer to the person who shall have sown with Hemp, in drills at least eighteen inches asunder, the greatest quantity of land in any part of the United Empire, not less than fifty acres statute measure, in the year 1818, and shall have at the proper season caused to be plucked the summer Hemp (or male Hemp bearing seed) on the ground until the seed is ripe;—*the Gold Medal.*

28. To the person who shall sow with Hemp, in drills at least eighteen inches asunder, the next greatest quantity of land in any part of the United Empire, not less than twenty-five acres, statute measure, in the year 1818, and shall at the proper season cause the same to be plucked as above-mentioned;—*the Silver Medal.*

Certificates of the number of acres, of the distance of the drills, of the plucking of the Hemp, with a general account of the soil, cultivation, and produce, to be delivered to the Society, along with fourteen pounds of the Hemp and two quarts of the seed, on or before the second Tuesday in February, 1819.

POTATOES.

29. To the person who shall, in the year 1818, cultivate the greatest quantity of land which has not been used for the cultivation of Potatoes for the space of twelve years past, not less than fifty acres, with Potatoes of such qualities as to be fit for the use of the table in the months of April, May, and June, after their growth the preceding year;—*the Gold Medal* or *Thirty Guineas.*

30. For the next greatest number, not less than twenty acres;—*the Silver Medal* or *Fifteen Guineas.*

Proper certificates, along with other necessary particulars, to be delivered in to the Society on or before the first Tuesday in April, 1819.

31, 32. These premiums are extended one year farther on similar conditions.

### PRESERVING TURNIPS.

33. To the person who shall discover to the Society the best and cheapest method of preserving Turnips perfectly sound, and in every respect fit for the purpose of supporting and fattening sheep and neat cattle during the months of February, March, and April;—*the Gold Medal.*

It is required that a full and accurate account of the method employed, and the expense attending the process, together with certificates that the produce of four acres at the least has been preserved according to the method described, and applied to the feeding of sheep and neat cattle; that the whole were drawn out of the ground before the first day of February, in order to clear the greater part of it previous to its being prepared for corn, and to save the soil from being exhausted by the turnips; and also of the weight of an average sixteen perches of the crop; be produced to the Society on or before the last Tuesday in February, 1819.

34. For the next in quantity and merit, on not less than two acres;—*the Silver Medal.*

### PRESERVING CABBAGES.

35. To the person who shall discover to the Society the best and cheapest method of preserving drum-headed Cabbages perfectly sound, and in every respect fit for the purpose of supporting and fattening sheep and neat cattle during the months of February, March, and April;—*the Gold Medal.*

36. For the next in quantity and merit, on not less than two acres;—*the Silver Medal.*

Conditions the same as for preserving turnips, Art. 33.—And the accounts to be produced on or before the last Tuesday in February, 1819.

### PRESERVING CARROTS, PARSNIPS, BEETS, OR MANGEL WORZEL.

37. To the person who shall discover to the Society the best and cheapest method of preserving Carrots, Parsnips, Beets, or Mangel Worzel, perfectly sound, and in every respect fit for the purpose of supporting horses and fattening sheep and neat cattle, during the months of February, March, and April;—*the Gold Medal.*

Conditions the same as for preserving turnips, Art. 33.—And the accounts to be delivered in on or before the last Tuesday in February, 1819.

38. For the next in quantity and merit, on not less than two acres;—*the Silver Medal.*

### MAKING MEADOW-HAY IN WET WEATHER.

39. To the person who shall discover to the Society the best and cheapest method, superior to any hitherto practised, of making Meadow Hay in wet weather;—*the Gold Medal.*

A full account of the method employed, and of the expense attending the process, with not less than fifty-six pounds of the Hay; and certificates that at least the produce of six acres of land has been made according to the method described, and that the whole is of equal quality with the sample; to be produced on or before the first Tuesday in February, 1819.

### HARVESTING CORN IN WET WEATHER.

40. To the person who shall discover to the Society the best and cheapest method, superior to any hitherto practised, of Harvesting Corn in Wet Weather;—*the Gold Medal.*

A full account of the method employed, and of the expense attending the process, with not less than two sheaves of the Corn, and certificates that at the least the produce of ten acres has been harvested according to the method described, and that the whole is of equal quality with the samples; to be produced on or before the first Tuesday in February, 1819.

### GAINING LAND FROM THE SEA.

41. To the person who shall have

gained the greatest quantity of Land from the Sea, not less than fifty acres, on the coast of Great Britain or Ireland; —*the Gold Medal.*

Certificates of the quantity of Land, and that the experiments were begun after the first of January, 1813, to be produced to the Society on or before the first Tuesday in February, 1819.

42. The same premium is extended one year farther.

### IMPROVING WASTE LAND.

43. For the most satisfactory account of the best method of improving any one of the following soils, being Land lying Waste and Uncultivated, viz. clay, gravel, sand, chalk, peat earth, or bog, verified by experiments on not less than fifty acres of land;—*the Gold Medal.*

44. For the next greatest quantity, not less than thirty acres:—*the Silver Medal.*

It is required, that the Land, before such improvement, be absolutely uncultivated, and in a great measure useless, and that, in its improved state, it be enclosed and cultivated.

Certificates of the number of acres, of the quality of the Land so improved, with a full account of every operation and expense attending such improvement, the state it is in as to the proportion of grass to arable, and the average value thereof, to be produced on or before the first Tuesday in February, 1819.

### SPADE HUSBANDRY.

45. For the best set of experiments, made on not less than eight acres of land, four of them to be cultivated by the ordinary mode, and four by the Spade; for the purpose of ascertaining the comparative advantages of the plough and Spade culture as applied to any one of the following crops: viz. flax, lucern, carrots, parsnips, mangel worzel or turnips;—*the Gold Medal* or *Thirty Guineas.*

It is required that each mode of culture be fully described, and that proper certificates of the nature and condition of the Land on which the experiments are made, together with the expense attending each mode, as also of the produce of each, be sent to the Society on or before the first Tuesday in February, 1819.

### MANURES.

46. For the most satisfactory set of experiments, to ascertain the comparative advantages of the following Manures, used as top-dressings on grass and corn land, viz. soot, coal-ashes, wood-ashes, lime, gypsum, bones, night-soil, or any other fit article;—*the Gold Medal.*

It is required that the above experiments be made between two or more of the above-mentioned Manures, and that not less than two acres of land be dressed with each Manure.

An account of the nature of the soil, quantity, and expense of the manure and crops, with certificates, to be produced on or before the last Tuesday in February, 1819.

### IRRIGATION OF LAND.

47. To the person who shall discover to the Society the cheapest and most effectual method of raising water in quantities sufficient to be beneficially employed for the purpose of irrigating land, superior to, and cheaper than any other method now in use;—*the Gold Medal*, or *Fifty Guineas.*

A model, on a scale of one inch to a foot, with certificates that a machine at large, on the same construction, has been used, specifying the quantity of water delivered in gallons per hour, and the height to which it was raised, to be produced to the Society on or before the first of March, 1819.

### PARING PLOUGH.

48. To the person who shall invent and produce to the Society a machine or Plough for the purpose of Paring land preparatory to burning, superior to any hitherto known or in use for such purpose, and to be worked by not more than one man and two horses;—*the Silver Medal* or *Twenty Guineas.*

The machine, and certificates that at least ten acres have been Pared by it in a proper manner, to be produced to the Society on or before the first of February, 1819.

### DIBBLING MACHINE.

49. To the person who shall invent a machine, superior to any hitherto known or in use, to answer the purpose of dibbling wheat, by which the holes for

receiving the grain may be made at equal distances and proper depths;—*the Silver Medal and Ten Guineas.*

The Machine, with certificates that at least three acres have been dibbled by it, to be produced to the Society on or before the second Tuesday in February, 1819.

### REAPING OR MOWING CORN MACHINE.

50. For inventing a machine to answer the purpose of Mowing or Reaping wheat, rye, barley, oats or beans, by which it may be done more expeditiously and cheaper than by any method now practised, provided it does not shed the Corn or pulse more than the methods in common practice, and that it lays the straw in such manner that it may be easily gathered up for binding;—*the Gold Medal.*

The machine, with certificates that at least three acres have been cut by it, to be produced to the Society on or before the second Tuesday in January, 1819. Simplicity and cheapness in the construction of this and the preceding Machine, will be considered as principal parts of their merit.

### THRASHING MACHINE.

51. To the person who shall invent a Machine by which corn of all sorts may be thrashed more expeditiously, effectually, and at a less expense, than by any method now in use;—*the Gold Medal.*

The Machine or a model, with proper certificates that such a Machine has been usefully applied, that at least thirty quarters have been thrashed by it, and of the time employed in the operation, to be produced to the Society on or before the last Tuesday in February, 1819.

### DESTROYING THE GRUB OF THE COCKCHAFER.

52. To the person who shall discover to the Society an effectual method, verified by repeated and satisfactory trials, of destroying the Grub of the Cockchafer, or of preventing or checking the destructive effects which always attend corn, peas, beans, and turnips, when attacked by those insects;—*the Gold Medal.*

The accounts, with proper certificates, to be produced on or before the first Tuesday in February, 1819.

### DESTROYING WORMS.

53. To the person who shall discover to the Society, an effectual method, verified by repeated and satisfactory trials, of destroying Worms, or of preventing the destructive effects they occasion on corn, beans, peas, or other pulse;—*the Silver Medal.*

The accounts, with proper certificates, to be produced to the Society, on or before the first Tuesday in February, 1819.

### DESTROYING THE FLY ON HOPS.

54. To the person who shall discover to the Society an easy and efficacious method of destroying the Fly on Hops, superior to any hitherto known or practised, on not less than four acres of Hop ground;—*the Gold Medal.*

Accounts and certificates to be delivered to the Society on or before the first Tuesday in February, 1819.

### PREVENTING THE BLIGHT ON FRUIT TREES AND CULINARY PLANTS.

55. To the person who shall discover to the Society the most effectual method of preventing the Blight, or Ravages of Insects, on Fruit Trees and Culinary Plants, superior to any hitherto known or practised, and verified by actual and comparative experiments;—*the Gold Medal.*

The accounts, with proper certificates, to be delivered to the Society on or before the second Tuesday in February, 1819.

### FOR SCRAPING THE BARK OF FRUIT TREES.

56. To the person who shall send to the Society the best account of experiments made by scraping the bark of Fruit Trees, according to the plan recommended by Sir John Sinclair, in his Treatise on the subject;—*the Silver Medal.*

Certificates that the experiments have succeeded, to be sent to the Society on or before the first Tuesday in March, 1819.

### CURE OF THE ROT IN SHEEP.

57. To the person who shall discover to the Society the best and most effectual method of curing the Rot in Sheep, verified by repeated and satisfactory experiments;—*the Gold Medal.*

It is expected that the Candidates furnish accurate accounts of the symptoms and cure of the disease, together with the imputed cause thereof, and the actual or probable means of prevention, which, with proper certificates, must be delivered to the Society on or before the first Tuesday in February, 1819.

### CURE OF THE FOOT-ROT IN SHEEP.

58. To the person who shall discover to the Society the best and most effectual method of curing the Foot-Rot in sheep;—*the Silver Medal.*

It is required that the cure be ascertained by repeated and satisfactory experiments, and the method of performing it be verified by proper certificates, delivered to the Society on or before the first Tuesday in February, 1819.

### PREVENTING THE ILL EFFECTS OF FLIES ON SHEEP.

59. To the person who shall discover to the Society the most effectual method of protecting sheep from being disturbed and injured by Flies;—*the Silver Medal.*

It is required that the method be ascertained by repeated experiments, and that a certificate of its efficacy be delivered to the Society on or before the first Tuesday in February, 1819.

### PROTECTING SHEEP.

60. To the person who, in the year 1818, shall have protected the greatest number of sheep, not fewer than one hundred, by hovels, sheds, or any other means;—*the Gold Medal.*

A particular account of the experiments made, with the advantages arising therefrom, together with the expense, and certificates of its utility, to be produced to the Society on or before the first Tuesday in March, 1819.

*N. B.* It is required that the certificates shall specify the length of time the sheep were so protected, and the manner in which they were maintained during that time; together with the general method of managing them.

### FEEDING CATTLE.

61. For the best experiments on Stall-feeding of Cattle (not less than five head), to be continued for the space of twelve months, in order to prove the earliest maturity and greatest propensity to fatten, of the most approved breeds of cattle in Great Britain, or Ireland, specifying the nature of the food given, together with the daily consumption of each beast, with its weekly increase in weight, and such other observations as may be deemed of consequence;——*the Gold Medal.*

A full account of the methods employed, and of the expenses attending the same, and certificates of the sundry matters stated, to be produced on or before the second Tuesday in January, 1819.

### BEES, WAX, AND HONEY.

62. To the person who shall erect, previous to the first day of September, 1818, an apiary, containing the greatest number of hives or boxes stocked with Bees, not less than one hundred;—*the Silver Medal*, or *Twenty Guineas.*

63. For the next greatest number, not fewer than fifty stocks;—*Ten Guineas.*

Proper certificates of the number of stocks, and that they have been in the possession of the claimant during the preceding summer, to be produced to the Society on or before the first Tuesday in March, 1819.

It is expected that the claimant will give such particular information on the subject, as may tend to benefit the public, and enable other persons to keep bees to advantage; also that improved methods be made use of in their management, and particularly that the bees be not destroyed in order to obtain their Honey and Wax.

# *PREMIUMS*

FOR DISCOVERIES AND IMPROVEMENTS IN

# CHEMISTRY, DYEING, AND MINERALOGY.

### INCREASING STEAM.

64. To the person who shall invent and discover to the Society a method, verified by actual experiments, of increasing the quantity or force of Steam in Steam Engines, with less fuel than has hitherto been employed, provided that in general the whole amount of the expenses in using steam engines may be considerably lessened;—*the Gold Medal*, or *Fifty Guineas.*

To be communicated to the Society on or before the first Tuesday in January, 1819.

### PREVENTING THE DRY-ROT IN TIMBER.

65. To the person who shall discover to the Society the cause of the Dry-Rot in Timber, and disclose a certain method of prevention superior to any hitherto known;—*the Gold Medal*, or *Thirty Guineas.*

The accounts of the cause and method of prevention, confirmed by repeated experiments, to be produced to the Society on or before the last Tuesday in Dec. 1818.

*Note.*—For a method of curing and preventing the dry-rot in ship timber, see Mr. Bowden's communication in Vol. 36 of the Society's Transactions.

### STATUARY MARBLE.

66. To the person who shall discover, within Great Britain or Ireland, a quarry of White Marble fit for the purposes of statuary, and equal to those kinds now imported from Italy;—*the Gold Medal*, or *One Hundred Guineas.*

A block of at least three feet in length, two in height, and two in width, with an account of the situation of the quarry, and certificates of its possessing considerable extent, to be produced to the Society on or before the first Tuesday in February, 1819.

*N. B.* In order to prevent useless expense or trouble to the Claimant in forwarding so large a block, the Society will be ready to examine any smaller specimen of the marble, and express their opinion of its value to the Candidate before the block required by the above premium is produced.

### PREVENTING THE ILL EFFECTS OF SMELTING ORES.

67. To the person or persons who shall invent and discover to the Society the most effectual method or methods of preventing the ill effects arising to vegetation and animal life, from the sulphureous, arsenical, or other noxious fumes disengaged in smelting the ores of Copper, Zinc, Lead, Tin, Iron, &c. in the large way, and if possible, of converting those pernicious fumes to useful purposes, in a manner superior to any hitherto known or in use;—*the Gold Medal*, or *Fifty Guineas.*

It is required that a full account of the process employed, with certificates of its being successfully carried into effect, be produced to the Society on or before the first Tuesday in March, 1819.

### FINE BAR IRON.

68. To the person, in Great Britain, who shall make the greatest quantity of Bar-iron, not less than ten tons, with coak, from coak pigs, equal in quality to the best iron imported from Sweden or Russia, and as fit for being converted into steel;—*the Gold Medal*, or *Fifty Guineas.*

Samples, not less than one hundred weight, with certificates that the whole quantity is of equal quality, to be produced to the Society on or before the first Tuesday in January 1819.

### REFINING COPPER FROM THE ORE.

69. To the person who shall discover to the Society a method of separating,

purifying, and refining Copper from the Ore, so as to render it fit for those purposes to which fine copper is now applied, and by a process cheaper than and superior to any hitherto known or in use;—*the Gold Medal*, or *Fifty Guineas.*

Certificates that not less than three tons have been so prepared or refined, and a quantity not less than one hundred weight of the copper so refined, to be produced to the Society on or before the first Tuesday in February, 1819.

### PREPARING BRASS.

70. To the person or persons who shall discover a method of making Brass from materials the produce of Great Britain or Ireland, of superior quality to that commonly manufactured in this country, and equal to foreign brass;—*the Gold Medal*, or *Thirty Guineas.*

A full account of the process, and of the ingredients employed, together with their proportions, and certificates that one ton has been so manufactured, and a sample of the brass, not less than 14 lbs. to be produced to the Society on or before the last Tuesday in January, 1819.

### PREPARATION OF SULPHURIC ACID, FROM SULPHUR, WITHOUT THE USE OF ANY NITRIC SALT.

71. To the person who shall prepare the largest quantity (not less than one ton) of Sulphuric Acid from sulphur, without any nitric salt, of a specific gravity not inferior to the best sulphuric acid of commerce;—*the Gold Medal*, or *Fifty Guineas.*

Certificates that not less than the above quantity of such an acid has been prepared, together with a sample, to be produced to the Society on or before the first Tuesday in January, 1819.

### PREPARATION OF ANY ALKALINE OR EARTHY NITRATE.

72. To the person who shall prepare, in Great Britain, the largest quantity, not less than one hundred weight, of any salt of Nitric Acid, with either earths or alkalies, by a method superior to, and as cheap as those hitherto practised;—*the Gold Medal*, or *One Hundred Guineas.*

Certificates of the above quantity having been prepared, and a sample of not less than 28lbs. to be produced to the Society on or before the last Tuesday in January, 1819.

### GLAZING EARTHEN-WARE WITHOUT LEAD, OR ARSENIC.

73. To the person who shall discover to the Society, the cheapest, safest, most durable, and most easily fusible composition, fit for the purpose of glazing Earthenware, without any preparation of lead, arsenic, or other pernicious ingredients, and superior to any hitherto in use;—*the Gold Medal*, or *Thirty Guineas.*

Specimens of the ware so glazed, with proper certificates of its having succeeded, and a sample of the materials made use of, to be produced to the Society on or before the first Tuesday in February, 1819.

### DYEING SILK OR WOOLLEN.

74. To the person who shall discover a method of dyeing Silk or Woollen, of any colours, superior to the same produced by other British dyers, and equal to those produced by the Continental dyers;—*the Gold Medal*, or *Thirty Guineas.*

A full account of the process and ingredients employed, together with their proportions, attested by satisfactory certificates, as well as samples of the silk and woollen in its undyed and dyed state, to be produced to the Society on or before the first Tuesday in January, 1819.

### PREPARATION OF A RED STAIN FOR COTTON CLOTH.

75. To the person who shall communicate to the Society the most effectual method of printing or staining cotton cloths with a red colour, by an immediate application of the colouring matter to the cloth, equally beautiful and durable with the red colours now generally procured from decoctions of madder;—*the Gold Medal*, or *Fifty Guineas.*

Certificates that the above process has been advantageously used on ten pieces of calico, each twenty-one yards or upwards in length; one piece of the calico so printed, one pound of the colour, and a full account of the

preparation and application, to be produced to the Society on or before the second Tuesday in January, 1819.

### PREPARATION OF A GREEN COLOUR FOR PRINTING COTTON CLOTH.

76. To the person who shall communicate to the Society the best method of printing with a full green colour on cotton cloth, by an immediate application of the colouring matter from a wooden block to the cloth, equally beautiful and durable as the colours now formed from the complicated process of the decoction of weld, and the solutions of indigo;—*the Gold Medal*, or *Fifty Guineas.*

Certificates and conditions as for Premium 75.

### BRITISH INDIGO.

77. To the person who shall prepare Indigo, or a substance equal to it, from any plants (except woad), the growth of Great Britain or Ireland, at a price not greater than that of foreign indigo of equal quality;—*the Gold Medal*, or *Fifty Guineas.*

A full account of the process and ingredients employed, together with their proportions, and satisfactory certificates that at least one cwt. of the indigo has actually been prepared; also a sample of the same weighing not less than 7 lbs. to be produced to the Society on or before the last Tuesday in January, 1819.

### WHITE SUBSTITUTE FOR THE BASIS OF PAINT.

78. To the person who shall produce to the Society the best white substitute, superior to any hitherto known, for the basis of paint, equally proper for the purpose as the white-lead now employed; such substitute not to be of a noxious quality, and to be afforded at a price not materially higher than that of white-lead;—*the Gold Medal*, or *One Hundred Guineas.*

A quantity of the substitute, not less than 50 lbs. weight, with an account of the process used in preparing it, and certificates that at least one hundred weight has been manufactured, to be produced to the Society on or before the first Tuesday in January, 1819.

### PERMANENT WHITE PAINT FOR THE USE OF ARTISTS.

79. To the person who shall produce to the Society a White Paint for oil, superior to any hitherto known, and which is not liable to be discoloured by exposure to light or to sulphuretted hydrogen gas;—*the Gold Medal*, or *Thirty Guineas.*

A full account of the process, and 1 lb. of the colour to be produced to the Society, on or before the second Tuesday in January, 1819.

### RED PIGMENT.

80. To the person who shall discover to the Society a full and satisfactory process for preparing a Red Pigment, fit for use in oil or water, equal in tone and brilliancy to the best carmines and lakes now known or in use, and perfectly durable;—*the Gold Medal*, or *Fifty Guineas.*

One pound weight of such colour, and a full disclosure of its preparation, to be produced to the Society on or before the first Tuesday in February, 1819.

*N. B.* It is required that the colour should remain unaltered by the common exposure to strong light, damps, and noxious vapours.

### ULTRAMARINE.

81. To the person who shall prepare an artificial Ultramarine, equal in colour, brilliancy, and durability, to the best prepared from lapis lazuli, and which may be afforded at a cheaper rate;—*the Gold Medal*, or *Thirty Guineas.*

The conditions are the same as in the preceding premium for the red pigment.

### COLOURLESS LAC VARNISH.

82. To the person who shall produce to the Society a Lac Varnish equally hard with that made from shell or seed lac, and as fit for use in the arts, but deprived of its colouring matter;—*the Silver Medal*, or *Twenty Guineas.*

A full account of the process, and one quart of the varnish to be produced to the Society on or before the second Tuesday in January, 1819.

### SUBSTITUTE FOR TAR.

83. To the person who shall invent

and discover to the Society the best substitute for Stockholm tar, equal in all its properties to the best of that kind, and prepared from materials the produce of the United Kingdom and its colonies;—*the Gold Medal*, or *One Hundred Guineas.*

A quantity of the substitute, not less than one hundred weight, with certificates that at least one ton has been manufactured, and that it can be afforded at a price not exceeding that of the best foreign tar, together with an account of the process, to be delivered to the Society on or before the first Tuesday in March, 1819.

*N. B.*—Considerable quantities of tar are produced in Sweden and Norway from the roots of fir trees burnt for that purpose.

### TURPENTINE FROM THE SCOTCH FIR, OR PINUS SYLVESTRIS.

84. For the greatest quantity of Turpentine, not less than two hundred weight, prepared in Great Britain, from that species of fir called the Scotch fir, or Pinus sylvestris, Linn.;—*the Gold Medal.*

Certificates of the turpentine being prepared from such trees of British growth, together with fifty-six pounds of the turpentine, to be delivered to the Society on or before the second Tuesday in January, 1819.

85. For the next greatest quantity prepared, not less than one hundred weight, on similar conditions;—*the Silver Medal.*

*N. B.* The Society being in possession of the method practised for extracting turpentine from trees whilst growing, and of samples so procured, information will be given upon that subject, on application for that purpose, at the Society's house.

### PREPARATION OF TAN.

86. To the person who shall prepare, in the most concentrated form, so as to be easily portable, and at a price applicable to the purposes of manufacturers, the largest quantity, not less than one hundred weight, of the principle called Tannin, which abounds in oak, bark, and many other vegetable substances;—*the Gold Medal*, or *Thirty Guineas.*

Certificates of the superior quality of the quantity so prepared, and a sample of not less than 28 lbs. to be produced to the Society on or before the last Tuesday in January, 1819.

### PRESERVING SEEDS OF VEGETABLES.

87. For the best method of preserving Seeds of Plants in a state fit for vegetation a longer time than has hitherto been practised, such method being superior to any known to the public, and verified by sufficient trial, to be communicated to the Society on or before the last Tuesday in December, 1818;—*the Gold Medal*, or *Thirty Guineas.*

### PRESERVING SALTED PROVISIONS FROM BECOMING RANCID OR RUSTY.

88. To the person who shall discover to the Society the best, cheapest, and most efficacious method of preserving Salted Provisions from becoming rancid or rusty;—*the Gold Medal*, or *Thirty Guineas.*

A full description of the method, with proper certificates that it has been found on repeated trials to answer the purpose intended, to be produced to the Society on or before the first Tuesday in February, 1819.

### DESTRUCTIVE EFFECTS FROM MOTHS.

89. To the person who shall discover to the Society a cheap, easy, and effectual method, verified by repeated and satisfactory trials, of preventing the destructive effects occasioned by Moths and other Insects, in furs, woollens, and other articles, superior to any hitherto known or practised;—*the Silver Medal*, or *Fifteen Guineas.*

The accounts, with proper certificates, to be produced to the Society on or before the first Tuesday in January, 1819.

### PRESERVING IRON FROM RUST.

90. To the person who shall inven and discover to the Society a cheap composition superior to any now in use, which shall effectually preserve Wrought Iron from rust;—*the Gold Medal*, or *Fifty Guineas.*

A full description of the method of preparing the composition, with certi-

ficates that it has stood at least two years unimpaired, being exposed to the atmosphere during the whole time, to be produced to the Society, with ten pounds weight of the composition, on or before the first Tuesday in January, 1819.

### INDELIBLE INK.

91. To the person who shall discover to the Society a method of making a Black Ink proper for writing, superior to any at present known, indestructible by chemical applications, and not dearer than that which is now in common use; —*the Silver Medal*, or *Fifteen Guineas.*

Certificates that not less than two gallons of such ink have been actually prepared, and found to possess the qualities above mentioned, with a full detail of the process of making it, and two quarts of the ink, to be delivered to the Society on or before the second Tuesday in January, 1819.

### RENDERING LEATHER WATER-PROOF.

92. To the person who shall discover a method, superior to any now in use, and of moderate price, of rendering Leather Water-proof, without injuring its texture or pliability;—*the Silver Medal*, or *Fifteen Guineas.*

A full account of the process, and of the ingredients employed, together with their proportions, attested by satisfactory certificates, as well as samples of the leather in its unprepared and prepared state, to be produced to the Society on or before the last Tuesday in January, 1819.

### REFINING WHALE OR SEAL OIL.

93. For disclosing to the Society an effectual method of purifying Whale or Seal Oil from the glutinous matter that incrusts the wicks of lamps, and extinguishes the light, though fully supplied with oil;—*the Gold Medal*, or *Fifty Guineas.*

It is required that the whole of the process be fully and fairly disclosed, in order that satisfactory experiments may be made by the Society to determine the validity of the claim; and certificates that not less than twenty gallons have been purified according to the process delivered in, together with two gallons of the oil in its unpurified state, and two gallons so refined, to be produced to the Society on or before the second Tuesday in February, 1819.

### MANUFACTURING TALLOW CANDLES.

94. To the person who shall discover to the Society a method of hardening or otherwise preparing Tallow, so that candles may be made of it which will burn as clear and with as small a wick as wax candles, without running, and may be afforded at a less expense than any at present made with spermaceti;—*the Gold Medal*, or *Fifty Guineas.*

Certificates that 112 lbs. of such tallow have been made into candles, and 12 lbs. of the candles made thereof, to be produced to the Society on or before the second Tuesday in January, 1819.

### CANDLES FROM RESIN, OR OTHER SUBSTANCES.

95. To the person who shall discover to the Society the best method of making Candles of Resin, or of any other substance fit for common use, at a price much inferior to those made of tallow only, or of a much superior quality at the same price as those made of tallow;—*the Gold Medal*, or *Thirty Guineas.*

Six pounds at least of the candles so prepared, with an account of the process, to be delivered to the Society on or before the last Tuesday in December, 1818.

### MINERALOGICAL COUNTY MAPS.

96. To the person who shall complete and publish the best Mineralogical Map of any County in the United Kingdom, on a scale of not less than one inch to a mile, containing an account of the situation of the different mines therein, and describing the kinds of minerals thence produced, with sections of the strata;—*the Gold Medal*, or *Fifty Guineas.*

Certificates of the accuracy of such maps, together with the maps, to be produced to the Society on or before the first Tuesday in February, 1819. The maps to remain the property of the Society.

MINERALOGICAL MAP OF IRELAND.

97. To the person who shall complete and publish an accurate Mineralogical Map of Ireland, on a scale of not less than five miles to an inch, containing particulars described in the foregoing premium;—*the Gold Medal*, or *Fifty Guineas.*

MINERALOGICAL MAP OF SCOTLAND.

98. The same premium is offered for a Mineralogical Map of Scotland, on similar conditions.

NATURAL HISTORY.

99. To the author who shall publish, in the year 1818, the Natural History of any County in the United Kingdom;—*the Gold Medal*, or *Fifty Guineas.*

It is required that the several natural productions, animal, vegetable, and mineral, peculiar to the county, or found therein, be carefully and scientifically arranged and described, in order that the public may be enabled to judge what arts or manufactures are most likely to succeed in such county. The work to be delivered to the Society on or before the last Tuesday in January 1819, and a copy to be the property of the Society.

## *PREMIUMS IN POLITE ARTS.*

HONORARY PREMIUMS FOR PAINTINGS OR DRAWINGS BY NOBILITY.

100. For the best original Painting or Drawing of any kind, by young gentlemen under the age of twenty-one, sons or grandsons of peers or peeresses in their own right, of Great Britain or Ireland;—*the Gold Medal.*

101. For the best copy, on similar conditions;—*the Silver Medal.*

102. For the best original Painting or Drawing, of any kind, by young ladies under the age of twenty-one; daughters or grand-daughters of peers and peeresses in their own right, of Great Britain or Ireland;—*the Gold Medal.*

103. For the best copy, on similar conditions;—*the Silver Medal.*

HONORARY PREMIUMS FOR PAINTINGS OR DRAWINGS BY GENTLEMEN AND LADIES.

104. For the best original Painting or Drawing of any kind, by young gentlemen under the age of twenty-one;—*the Gold Medal.*

105. For the best Copy, on similar conditions;—*the Silver Medal.*

106. For the best original Painting or Drawing of any kind, by young ladies under the age of twenty-one;—*the Gold Medal.*

107. For the best Copy, on similar conditions;—*the Silver Medal.*

*N. B.* As the foregoing honorary premiums are intended only for the nobility and gentry, persons professing any branch of the polite arts, or any business dependent on the arts of design, or the sons and daughters of such persons, will not be admitted candidates in the above classes.

PREMIUMS FOR PAINTINGS AND DRAWINGS BY ARTISTS AND OTHERS.

108. For the best Historical Painting in oil colours, by persons of either sex, under the age of 25;—*the Gold Medal.*

109. For the best Historical Drawing by persons of either sex, under the age of 25;—*the Gold Medal.*

110. For the best copy in oil colours, of an Historical Painting, by persons of either sex, under the age of 21;—*the Silver Medal.*

111. For the best Historical Drawing, being a copy, by persons of either sex, under the age of 21;—*the Silver Isis Medal.*

112. For the best original Landscape, in oil, by persons of either sex, under the age of twenty-five;—*the Gold Isis Medal.*

113. For the best original Landscape in water colours, by persons of either sex, under the age of twenty-one;—*the Silver Medal.*

114. For the best copy of a Landscape, by persons of either sex, under the age of eighteen;—*the Silver Isis Medal.*

115. For the best original Painting or Drawing of fruit or flowers, by persons of either sex, under the age of twenty-one;—*the Silver Medal.*

116. For the best finished Drawing of the Theseus of the Elgin collection in the British Museum; the size of the Drawing not less than eighteen inches high, by persons of either sex, under the age of twenty-one;—*the Silver Medal.*

117. For the best finished Drawing of the head of Hercules in a state of repose, by Glycon, marked No. in the British Museum, not less than twelve inches in height, by persons of either sex, under the age of twenty-one;—*the Silver Medal.*

DRAWINGS OF OUTLINES.

118. For the best Outline, after the plaster cast of the Mercury, commonly called the Antinous, by persons of either sex, under the age of twenty-one, the figure not less than eighteen inches;—*the Silver Medal.*

PERSPECTIVE DRAWINGS.

119. For the best Perspective Drawing by persons of either sex, under the age of twenty-one;—*the Silver Medal.*

ARCHITECTURAL DESIGNS.

120. For the best original Design for a nobleman's mansion, consisting of plan, elevation, and section, each to be the size of double elephant; the drawing to remain the property of the Society if required;—*the Gold Medallion.*

For the next in merit;—*the Silver Medallion.*

The following inscription to be engraved on these *Medallions;* "The Premium given by the Society for the Encouragement of Arts, Manufactures, and Commerce, in conformity to the Will of John Stock, Esq. of Hampstead."

MODELS.

121. For the best original Model of a group, by persons under the age of twenty-five;—*the Gold Medal.*

For the next in merit;—*the Gold Isis Medal.*

122. For a single figure by persons under the age of twenty-one;—*the Silver Medal.*

123. For the best restored Model of the Ilissus in the Elgin collection, not less than three feet in length;—*the Gold Isis Medal.*

*** The Model to be baked or cast in plaster, and a cast from the Model in each case to remain the property of the Society, if required.

ETCHING OF AN HISTORICAL SUBJECT.

124. For the best free Etching in historical composition, from a picture of eminence;—*the Gold Isis Medal.*

ETCHING OF A LANDSCAPE.

125. For the best free Etching in Landscape composition, from a picture of eminence;—*the Silver Medal.*

HISTORICAL ENGRAVINGS.

126. For the best finished Engraving in historical composition;—*the Gold Medal.*

LANDSCAPE ENGRAVING.

127. For the best finished Engraving in Landscape composition;—*the Gold Isis Medal.*

ENGRAVING OF A PORTRAIT.

128. For the best finished Engraving of a Portrait;—*the Gold Isis Medal.*

*N. B.* In the class of finished Engravings the Society requires an aqua-fortis impression, and a finished proof to be sent, and to remain with the Society.

ENGRAVING ON WOOD BLOCKS.

129. For the best Engraving on Wood Blocks of an historical subject, the size of the principal figure not less than six inches in height, and the Block to be at least twelve inches by nine;—*the Gold Isis Medal.*

Two or more impressions, with the Block, to be produced to the Society. The impressions, but not the Block, to remain the property of the Society.

LITHOGRAPHY.

130. For the best specimen in this art, executed on stone the produce of the United Kingdom or its Colonies;—*the Gold Isis Medal.*

A particular account of the process employed, and the name of the quarry whence the stone was taken, with six impressions of the drawing, to be produced to the Society.

MEDAL DIE ENGRAVING.

131. For the best Die Engraving either of a single figure or group, after the engraver's own design and model;—*the Gold Medal.*

132. For the best Die Engraving of a design appropriate either to Mechanics, Chemistry, or Colonies and Trade. The size of the Die not to exceed two inches; —*the Gold Medal.*

The Dies, with two impressions or casts, and the model, in each claim for Medal Die sinking, are to be produced to the Society, and the impressions or casts to remain the property of the Society.

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CONDITIONS

FOR THE POLITE ARTS.

All articles in the class of Polite Arts, whether for claims or bounties, are to be produced to the Society on or before the first Tuesday in March, 1819, and none can be received after that day.

No person having received a premium or bounty, shall afterwards receive an equal or inferior one in the same class of art. No Candidate shall receive more than one premium in one year.

No more than one performance in any class shall be received from the same Candidate.

All performances to which premiums or bounties are adjudged shall remain with the Society until after the second Wednesday in June, 1819, when they will be re-delivered, unless mentioned in the premiums to the contrary.

No performance shall be admitted, that has obtained a reward from any other society, or academy, or has been offered for that purpose.

It is required, that the subjects for which premiums are offered, be delivered in without the names, or any external intimation to whom they belong; that the claimant affix to his performance whatever mark he pleases, and that the same mark be inscribed on a paper sealed up, containing *within*, the name and residence of the Candidate, and *on the outside* the age and sex, and the number of the premium in claim of which the performance is offered; the name not to be disclosed unless the Candidate be successful, or in consequence of a special vote of the Society. No production can be received with a view to obtain a bounty, which could have come into any of the foregoing classes.

To encourage real merit, and to prevent attempts to impose on the Society by producing drawings made or retouched by any other person than the Candidate, the Society require a specimen of the abilities of each successful Candidate, to be made under the inspection of the Committee of Polite Arts.

All Candidates in the Polite Arts are required to signify, on their drawings, whether the performances are originals or copies; and if possible to send the originals from which copies are taken.

All copies of drawings, &c. are to be on a different scale from the original.

The Society reserve to themselves the power of giving a Medal of less value than the premium offered, or of withholding the same altogether, in cases where the performance shall be deemed undeserving of reward.

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## *PREMIUMS FOR ENCOURAGING AND IMPROVING MANUFACTURES.*

EMPLOYMENT OF FEMALES.

133. To the person who shall instruct and employ the greatest number of females, not fewer than twenty, in the making of men's clothes, particularly of woollen cloth, and not being for the use of the army or navy;—*the Gold Medal*, or *Fifty Guineas.*

Certificates that the number of women above mentioned have been constantly so employed for at least three months, to be produced to the Society on or before the last Tuesday in March, 1819.

134. For the next greatest number of women so employed, not fewer than ten;—*the Silver Medal*, or *Fifteen Guineas*, on similar conditions.

CLOTH FROM HOP-STALKS, NETTLES, *&c.*

135. To the person who shall produce to the Society the greatest quantity, not less than thirty yards, of cloth, at least 27 inches wide, made in Great Britain or Ireland, of Hop Stalks or bines, nettles, or other raw vegetable substances, the produce of Great Britain or Ireland, su-

perior to any hitherto manufactured from such substances, and which can be generally afforded as cheap as cloth of equal quality and appearance now made from hemp, flax, or cotton, and much finer in quality than any hitherto manufactured in England from Hop Stalks, &c.;—*the Gold Medal*, or *Thirty Guineas.*

One pound of the thread of which the Cloth is made, and thirty yards of the Cloth, together with proper certificates that the whole is manufactured from Hop Stalks, or bines, &c. to be produced to the Society on or before the last Tuesday in December, 1818.

*N. B.* The Society is already in the possession of Cloth made in England from Hop Stalks or Bines, and Nettles, which may be inspected by application to the house-keeper.

### SHEEP'S WOOL.

136. To the person who shall prove to the Society, that he has sold the largest quantity of Merino Wool, or such Wool as will answer the same purpose, being the produce of his own flock, in the United Kingdom, for the purpose of being manufactured into superfine cloth, the quantity of Wool not less than five hundred weight, in the year 1818;—*the Gold Medal.*

Certificates, along with samples of the wool, and of the cloth manufactured from it, to be produced to the Society on or before the last Tuesday in March, 1819.

137. For the next greatest quantity, not less than two hundred and fifty pounds;—*the Silver Medal*, on similar conditions.

### WICKS FOR CANDLES OR LAMPS.

138. To the person who shall discover to the Society, a method of manufacturing hop-stalks or bines, nettles, or any other cheap material, the growth of the United Kingdom, so as to render them equally fit for the purpose of supplying the place of cotton, for Wicks of Candles or Lamps;—*the Silver Medal*, or *Twenty Guineas.*

Samples, not less than 5 lbs. weight, of the Wicks so prepared, to be produced to the Society on or before the last Tuesday in December, 1818, with certificates that the whole quantity is equal in quality to the sample.

### WICKS FOR CANDLES.

139. To the person who shall make known to the Society the most satisfactory result of a series of experiments actually made by him to determine the best thickness of Cotton Wicks for Candles, so as to obviate the defects of those commonly used;—*the Silver Medal*, or *Ten Guineas.*

Certificates that not less than one hundred weight have been so made, and six pounds of the candles, to be produced to the Society, on or before the last Tuesday in February, 1819.

*N. B.* The intention in offering this premium is, to ascertain the proper thickness or bulk of the Wick in proportion to that of the tallow, and to remove the unpleasant consequences and waste arising from the sparkling, or guttering of the candles in common use.

### PAPER FROM RAW VEGETABLE SUBSTANCES.

140. To the person who shall, between the first of January, 1818, and the first of January, 1819, make the greatest quantity, and of the best quality, (not less than ten reams) of good and useful paper, from raw vegetable substances, the produce of Great Britain or Ireland, and which have not been used in manufacturing paper previous to January, 1815, superior to any hitherto manufactured from such substances, and which can be generally afforded as cheap as paper of equal quality and appearance now made from rags;—*the Silver Medal*, or *Twenty Guineas.*

*N. B.* The object of the Society being to add to the number and quantity of raw materials used in this manufacture, it is their wish to include every useful sort of paper, and to introduce such natural products as can be easily and cheaply procured in great quantities. The Society are in possession of two volumes containing a great variety of specimens of paper made from raw vegetable substances, viz. nettles, potato-haulm, poplar, hop-bines, &c. which volumes may be inspected by any person on application to the Housekeeper.

Certificates of the making such Paper, and one ream of the Paper, to be produced on or before the second Tuesday in January, 1819.

### TRANSPARENT PAPER.

141. To the person who shall discover to the Society a method of making Paper from the pulp, that shall be perfectly transparent, and of a substance and body equal to foolscap, that shall take and bear common writing-ink with the same facility and correctness as Writing-paper generally in use;—*the Silver Medal*, or *Twenty Guineas.*

Certificates of the making such Paper, an account of the process, and one ream of the Paper, to be produced on or before the second Tuesday in January, 1819.

(India Paper, see page xxix.)

### CHINTZ PATTERNS FOR CALICO PRINTERS.

142. For the best original pattern in a new taste, of light and dark-ground Chintz for garment work, or furniture, fit for the purpose of Calico-printers, by persons of either sex;—*the Silver Medal.*

The pattern for which the premium is adjudged, to remain the property of the Society.

### COPPER-PLATE PATTERNS.

143. For the best pattern, in a new style, fit for the purpose of calico-printers for garment-work or furniture;—*the Silver Medal.*—The pattern for which the premium is adjudged, to remain the property of the Society.

*N. B.* The patterns to be produced on or before the last Tuesday in February, 1819.

### GLOVES.

144. To the person who shall make known to the Society a process equal to that of the French, or a superior one, for preparing, dyeing, and finishing the skins, verified by actual experiments, and the communication accompanied with at least a dozen pair of gloves made from skins so prepared in an equal or superior manner;—*the Gold Medal*, or *Forty Guineas.*

Certificates from competent persons, fully approving of the result of such experiments, together with the Gloves and communication, to be produced to the Society on or before the last Tuesday in March, 1819.

### CAT-GUT.

145. To the person who shall discover to the Society the best method of manufacturing, in the United Kingdom of Great Britain and Ireland, the intestines of sheep, lambs, goats, or of any other animals, into the article called Cat-gut, equally strong, clear, smooth, even, and free from knots, as the best Italian strings, and at a price not exceeding what they are usually sold for in England;—*the Gold Medal*, or *Thirty Guineas.*

Certificates that not less than fifty pounds weight have been so prepared by the claimant, with a full detail of the process, and samples of the articles of various thicknesses, to be produced to the Society on or before the first Tuesday in February, 1819.

146. For the next greatest quantity, not less than twenty-five pounds;—*the Silver Medal*, or *Twenty Guineas*, on similar conditions.

### HOSE FOR FIRE ENGINES, BREWHOUSES, &c.

147. To the person who shall invent a method of making Hose for Fire Engines, Brewhouses, &c. similar to those used on the Continent, made of flax or hemp, or other flexible material cheaper than leather;—*the Gold Isis Medal*, or *Thirty Guineas.*

A full account of the process used in manufacturing it, with certificates of its efficacy in practice, to be produced to the Society on or before the last Tuesday in February, 1819.

### THREAD FOR LACE.

148. To the person who shall invent or discover a method of manufacturing Thread from flax, for the making of Lace, of as fine quality as any used on the Continent;—*the Gold Medal*, or *Thirty Guineas.*

Samples of the Thread, not less than one pound in weight, and of the Lace made therefrom, together with certificates that not less than ten pounds in weight of each sort has been manufactured, to be produced to the Society, on or before the last Tuesday in March, 1819.

# *PREMIUMS IN MECHANICS.*

### GUNPOWDER MILLS.

149. To the person who shall invent and bring to perfection the most effectual method of so conducting the works of Gunpowder Mills in the business of making Gunpowder, as to prevent explosion;—*the Gold Medal*, or *One Hundred Guineas.*

Certificates and accounts of the method having been put in practice in one or more Gunpowder Mills in this kingdom, and that it promises, in the opinion of the best judges concerned in such works, to answer the purpose intended, to be produced to the Society on or before the first Tuesday in Feb. 1819.

*N. B.* As an encouragement to persons to turn their thoughts to improvements of this nature, if any should be made on the present method of conducting the business of Gunpowder making which fall short of the total prevention of explosion, and they are sent to the Society for the sake of humanity, the papers so sent in will receive due consideration; and such bounty or reward will be bestowed as they may appear to merit.

### TRANSIT INSTRUMENTS.

150. To the person who shall invent and produce to the Society a cheap and portable Transit Instrument which may easily be converted into a zenith sector, capable of being accurately and expeditiously adjusted for the purpose of finding the latitudes and longitudes of places, and superior to any portable Transit Instrument now in use;—*the Gold Medal*, or *Forty Guineas.*

To be produced on or before the last Tuesday in January, 1819.

### TAKING WHALES BY THE GUN-HARPOON.

151. To the person who shall strike and take the greatest number of Whales, not fewer than three, with the Gun-harpoon;—*Ten Guineas.*

Certificates of the striking such Whales, and that they were actually taken in the year 1818, signed by the master, or by the mate when the claim is made by the master, to be produced to the Society on or before the last Tuesday in December, 1818.

152. This Premium is extended one year farther, on similar conditions.

### FAMILY MILL.

153. To the person who shall invent and produce to the Society, the best constructed Mill for Grinding Corn for the use of private families, or parish poor; the construction to be such as to render the working of the Mill easy and expeditious, and superior to any hitherto in use;—*the Gold Medal*, or *Thirty Guineas.*

The Mill, and certificates of its having been used to good effect, to be produced to the Society on or before the first Tuesday in February, 1819. Cheapness and simplicity will be considered as essential parts of its merit; and the Mill, or a model, to remain with the Society.

### A PORTABLE MILL FOR GRINDING CORN.

154. To the person who shall invent and produce to the Society a portable Corn Mill, superior to any now in use;—*the Gold Isis Medal*, or *Thirty Guineas.*

The Mill, and certificates of its efficacy from actual use, to be produced to the Society on or before the last Tuesday in February, 1819.

### A PORTABLE OVEN.

155. To the person who shall invent and produce to the Society a Portable Oven, superior to any hitherto in use;—*the Silver Medal*, or *Twenty Guineas.*

The Oven, with certificates that it has been found to answer in use, to be produced to the Society, on or before the last Tuesday in February, 1819.

### MACHINE FOR RAISING COALS, ORE, &c. &c.

156. To the person who shall invent a machine for raising coals, ore, &c.

from mines, superior to any hitherto known or in use; and which shall produce the effect at a less expense than those already known or in use;—*the Gold Medal*, or *Fifty Guineas.*

A model of the Machine, made on a scale of not less than one inch to a foot, with a certificate that a machine at large on the same construction has been advantageously used, to be produced to the Society on or before the second Tuesday in February, 1819.

### IMPROVED WALKING-WHEEL, OR CRANE.

157. To the person who shall invent an improved Walking Wheel or Crane, on which the weight or power of any person or persons shall be applied with the greatest safety and effect, and so contrived that the power can be varied according to the greater or less weight to be raised or lowered;—*the Gold Medal*, or *Thirty Guineas.*

The model on a scale of not less than one inch to a foot, with a proper certificate that the machine at large has been employed to good effect, to be produced to the Society on or before the second Tuesday in February, 1819.

### MACHINE FOR RAISING WATER.

158. To the person who shall invent a machine on a better, cheaper, and more simple construction than any hitherto known or in use for raising water out of wells, &c. from a depth of not less than fifty feet;—*the Gold Medal*, or *Thirty Guineas.*

Certificates of the performance of the machine, and a model of it, on a scale of not less than one inch to a foot, to be produced to the Society on or before the first Tuesday in February, 1819.

### EXTINGUISHING FIRES.

159. To the person who shall produce to the Society the best and most effectual method of procuring an immediate supply of water in case of Fire, or for the means best calculated to prevent or extinguish accidental Fires in buildings, superior to any now in use;—*the Gold Medal*, or *Thirty Guineas.*

Certificates of the method having been practised with success, with a full description thereof, to be delivered to the Society on or before the second Tuesday in January, 1819.

### BORING AND BLASTING ROCKS.

160. To the person who shall discover to the Society a more simple, safe, cheap, and expeditious method than any hitherto known or in use, of Boring or Blasting rocks in mines, shafts, wells, &c.;—*the Gold Medal*, or *Thirty Guineas.*

Certificates of the methods having been practised with success, with a full description thereof, to be delivered to the Society on or before the first Tuesday in January, 1819.

### HEATING ROOMS FOR THE PURPOSE OF MANUFACTURERS.

161. To the person who shall invent and discover to the Society a method of Heating Rooms, superior to any hitherto known or in use, and at a moderate expense, for the purpose of painters, japanners, and other manufacturers, so as to avoid the necessity of iron or copper tunnels going through the rooms to convey the smoke, whereby the danger from such tunnels may be prevented;—*the Gold Medal*, or *Thirty Guineas.*

A model or complete drawing and description of the method, with certificates that it has been successfully practised, to be delivered to the Society on or before the last Tuesday in March, 1819.

### IMPROVED VENTILATION.

162. To the person who shall invent and produce to the Society a mode of permanently Ventilating the apartments in hospitals, workhouses, and other crowded places, superior to any now known or used;—*the Gold Medal*, or *Fifty Guineas.*

A model of the apparatus, and a full account of the means by which the effect has been produced, with proper certificates, to be delivered to the Society on or before the last Tuesday in February, 1819.

### PREVENTING ACCIDENTS FROM HORSES FALLING WITH TWO-WHEELED CARRIAGES.

163. To the person who shall invent and produce to the Society a method, superior to any hitherto known or in use, to prevent accidents from the falling of Horses with two-wheeled Carriages, especially on steep declivities;—*the Gold Medal*, or *Thirty Guineas.*

A model of the apparatus, and a full account of the means by which the effect has been produced, with proper certificates that the same has been used with success, to be delivered to the Society on or before the second Tuesday in January, 1819.

### IMPROVING TURNPIKE AND OTHER ROADS.

164. To the person who shall discover to the Society the most effectual and cheapest method, verified by actual experiments, of combining the materials ordinarily employed in making or repairing Roads, so as to form them of the hardest consistency by their cementing properties, or by an artificial mixture of earth, stones, &c. altered by heat, or any other mode, so as to form an even, hard, and durable carriage-road;—*the Gold Medal*, or *Thirty Guineas.*

It is required that an accurate account of the method used, and every ex-expense attending it, together with satisfactory certificates of its being effectual, be delivered to the Society on or before the first Tuesday in March, 1819.

### RAISING THE BODIES OF PERSONS WHO HAVE SUNK UNDER WATER.

165. To the person who shall invent and produce to the Society a cheap and Portable Drag, or other machine, superior to those now in use, for the purpose of taking up, in the best and most expeditious manner, and with the least injury, the bodies of persons who have sunk under water;—*the Gold Medal*, or *Thirty Guineas.*

The drag or machine, to answer the purpose intended, to be produced to the Society on or before the first Tuesday in March, 1819.

### FOR PREVENTING PREJUDICIAL EFFECTS TO THE PERSONS EMPLOYED IN POINTING NEEDLES.

166. To the person who shall invent and produce to the Society a mode of obviating the prejudicial effects that attend the operation of Pointing Needles, by grinding them dry, during which the particles of grindstone-dust, and steel, being thrown into the air, and received with it into the lungs, occasion asthma, consumption, and other painful disorders;—*the Gold Medal*, or *Thirty Guineas.*

A model of the apparatus, and a full account of the means by which the effect has been produced, together with proper certificates of its practicability and adoption, to be delivered to the Society on or before the second Tuesday in March, 1819.

### FOR PREVENTING ACCIDENTS FROM STAGE COACHES.

167. To the person who shall invent and discover to the Society a method or methods for preventing accidents arising from Stage Coaches;—*the Gold Medal*, or *Thirty Guineas.*

Ample certificates of its efficacy, and a description of the method, with models of the machinery used, to be produced to the Society on or before the last Tuesday in February, 1819.

*N. B.* The Society wish to impress strongly on the public the necessity of turning their attention to the above premium, from the number of accidents that daily occur; and suggest whether they might not in some degree be prevented, by an alteration in the manner of placing the luggage.

### A SUBSTITUTE FOR LEAD PIPES.

168. To the person who shall discover or invent and produce to the Society, a substitute for the Lead Pipes used for conveying malt and other liquors from the cellars to the bars of public houses;—*the Gold Medal*, or *Fifty Guineas.*

The substance of which the Pipe is made must be free from any poisonous or noxious quality, equally durable as lead, and at a moderate expense; and a specimen thereof, not less than ten yards in length, with a complete description of the process employed in forming it, must be produced to the Society on or before the last Tuesday in February, 1819.

### PREVENTING EXPLOSIONS IN STEAM-ENGINE AND OTHER COVERED BOILERS.

169. To the person who shall invent and discover to the Society a method of

rendering steam-engines and other covered boilers safer than any now in use, and less liable to accidents from explosion ;—*the Gold Medal, and not less than Thirty Guineas.*

Ample certificates that the method has been found to answer its intended purpose, to be produced to the Society, on or before the last Tuesday in February, 1819.

## *PREMIUMS OFFERED FOR THE ADVANTAGE OF THE COMMERCE OF THE UNITED EMPIRE.*

### TAKING PORPOISES.

170. To the people in any boat or vessel, who, in the year 1818, shall take the greatest number of Porpoises on the coast of Great Britain or Ireland, by gun-harpoon, or any other method, not fewer than thirty, for the purpose of extracting oil from them ;—*the Gold Medal*, or *Thirty Guineas.*

Certificates of the number, signed by the persons to whom they have been sold or delivered for the purpose of extracting the oil, to be produced to the Society on or before the last Tuesday in January, 1819.

### OIL FROM PORPOISES.

171. To the person who shall manufacture the greatest quantity of Oil from Porpoises taken on the coast of Great Britain or Ireland, in the year 1818, not less than twenty tons;—*the Gold Medal*, or *Thirty Guineas.*

Certificates of the oil having been made from porpoises actually caught on the coast of Great Britain or Ireland, and two gallons of the oil as a sample, to be produced to the Society on or before the last Tuesday in February, 1819.

### CURING HERRINGS.

172. To the person or persons who shall before January, 1819, cure the greatest quantity of White Herrings, not less than thirty barrels, equal in all respects to the best Dutch herrings, the same being caught in the British or Irish seas, and cured in a British or Irish vessel or port ;—*the Gold Medal*, or *Fifty Guineas.*

173. For the next greatest quantity, not less than fifteen barrels ;—*the Silver Medal*, or *Twenty Guineas.*

A sixteen gallon barrel of the herrings to be produced to the Society on or before the first Tuesday in February, 1819, with certificates that the conditions of the premium have been fulfilled, and that the whole were cured in the same manner as the specimen, together with a full description of the process employed.

### CURING MACKAREL.

174. To the person or persons who shall, before January, 1819, cure the greatest quantity of Mackarel, not less in number than ten thousand, in the best manner and to the satisfaction of the Society, the same being caught in the British or Irish seas, and cured in a British or Irish vessel or port ;—*the Gold Isis Medal*, or *Twenty-five Guineas.*

175. For the next greatest quantity, not less than five thousand ;—*the Silver Medal*, or *Fifteen Guineas.*

A sixteen gallon barrel of the mackarel to be produced to the Society on or before the first Tuesday in January, 1819, with certificates that the conditions of the premium have been fulfilled, and that the whole were cured in the same manner as the specimens, together with a full description of the process employed.

The same premiums to be extended one year further, on similar conditions.

*N. B.* Specimens of cured mackarel, which promise to afford a most valuable article of trade and food, even superior to herrings, have been sent to the Society, and have induced them to turn the attention of the public thereto, by offering the above premiums.

# *PREMIUMS OFFERED FOR THE ADVANTAGE OF THE BRITISH COLONIES.*

## NUTMEGS.

176. For the greatest quantity of Merchantable Nutmegs, not less than ten pounds weight, being the growth of his majesty's dominions in the West Indies, or any of the British settlements on the coast of Africa, or of the several islands adjacent thereto, and equal to those imported from the islands of the East Indies;—*the Gold Medal*, or *Fifty Guineas.*

Satisfactory certificates, from the governor or commander in chief, of the place of growth, with an account of the number of trees, their age, nearly the quantity of fruit on each tree, and the manner of culture, to be produced on or before the first Tuesday in Jan. 1819.

## KALI FOR BARILLA.

177. To the person who shall have cultivated, in the Bahama islands, or any other part of his majesty's dominions in the West Indies, or any of the British settlements on the coast of Africa, or the several islands adjacent thereto, in the year 1817, the greatest quantity of land, not less than two acres, with Spanish Kali fit for the purpose of making Barilla;—*the Gold Medal*, or *Thirty Guineas.*

178. For the next greatest quantity, not less than one acre;—*the Silver Medal*, or *Fifteen Guineas.*

Certificates, signed by the governor or commander in chief for the time being, of the quantity of land so cultivated, and of the state of the plants at the time of signing such certificates, to be delivered to the Society, with samples of the kali, on or before the second Tuesday in January, 1819.

## DESTROYING THE INSECT COMMONLY CALLED THE BORER.

179. To the person who shall communicate to the Society an effectual method of destroying the insect commonly called the Borer, which has of late years been so destructive to the sugar canes in the West India islands;—*the Gold Medal*, or *Fifty Guineas.*

The discovery to be ascertained by satisfactory certificates, under the hand and seal of the governor or commander in chief for the time being, and of some other respectable persons, inhabitants of the islands, or other place, in which the remedy has been successfully applied; such certificates to be delivered to the Society on or before the first Tuesday in January, 1819.

## CULTIVATION OF HEMP IN UPPER CANADA.

180. To the person who shall sow with Hemp the greatest quantity of land in the province of Upper Canada, not less than six arpents (each four-fifths of a statute acre), in the year 1817, and shall at the proper season cause to be plucked the summer Hemp (or male hemp bearing no seed), and continue the winter hemp (or female hemp bearing seed), on the ground until the seed is ripe;—*the Gold Medal*, or *One Hundred Dollars.*

181. To the person who shall sow with Hemp the next greatest quantity of land in the same province of Upper Canada, not less than five arpents, in the year 1816, in the manner above mentioned;—*the Silver Medal*, or *Eighty Dollars.*

182. For the next greatest quantity of land, in the same province, and in a similar manner, not less than four arpents;—*Sixty Dollars.*

183. For the next greatest quantity of land, in the same province, and in a similar manner, not less than three arpents;—*Forty Dollars.*

184. For the next greatest quantity of land, in the same province, and in a similar manner, not less than one arpent;—*Twenty Dollars.*

Certificates of the number of arpents, the method of culture, of the plucking of the hemp, with a general account whether sown broad cast or in drills, the expense, soil, cultivation and produce, to be transmitted to the Society, certified under the hand and seal of the governor or lieutenant-governor,

together with 28 lbs. of the hemp, and two quarts of the seed, on or before the last Tuesday in April, 1819.

### CULITVATION OF HEMP IN LOWER CANADA.

185 to 189. Premiums exactly similar in all respects to those held out for the province of Upper Canada, are also offered for the province of Lower Canada.

### CULTIVATION OF HEMP IN NOVA SCOTIA AND NEW BRUNSWICK.

190 to 194. Similar premiums in all respects are also offered to the provinces of Nova Scotia and New Brunswick.

### IMPORTATION OF HEMP FROM CANADA, NOVA SCOTIA, AND NEW BRUNSWICK.

195. To the master of that vessel which shall bring to this country the greatest quantity of Marketable Hemp, not less than one hundred tons, in the year 1818, the produce of Upper Canada, or of one of the above-mentioned provinces;—*the Gold Medal.*

196. To the master of that vessel which shall bring the next quantity, not less than fifty tons;—*the Silver Medal.*

Certificates, satisfactory to the Society, to be produced by the master of the vessel on or before the first Tuesday in February 1819, to testify that such hemp was grown and prepared in Canada, Nova Scotia, or New Brunswick.

### SUBSTITUTE FOR HEMP.

197. To the person who, in the year 1818, shall discover and produce to the Society a substitute for Hemp, equally cheap, durable, and applicable to all the purposes for which hemp is now used;—*the Gold Medal*, or *Fifty Guineas.*

A quantity of the substitute, not less than one hundred weight, together with the proper certificates from the governor or commander in chief, if raised in any of the British colonies, or from the Secretary of the Board of Trade, if raised in the East Indies, to prove that the same has been used with success, to be produced to the Society on or before the last Tuesday in February, 1819.

*N. B.* The premiums for Nos. 175, to 196, are all extended one year farther, on similar conditions.

### SILK.

198. For the greatest quantity of silk proper for manufactures, not less than one hundred pounds weight, produced by any person in the Isle of France, or in Malta, or islands near or adjacent thereto, in the possession of Great Britain, in the year 1817, from Silk-worms bred there;—*the Gold Medal*, or *Fifty Guineas.*

Specimens of the Silk, not less than one pound, with an account of the method in which the Silk-worms were managed; the kind and size of the mulberry-trees from whence they were furnished with food, and particulars respecting the culture of the mulberry-trees for that purpose, to be produced to the Society on or before the first Tuesday in March, 1819.

199. For the next greatest quantity not less than fifty pounds, on similar conditions;—*the Silver Medal*, or *Twenty Guineas.*

Satisfactory certificates from the governor or commander in chief of the district where the said Silk was produced, and of the several particulars above mentioned, to be delivered to the Society along with the samples required.

*N. B.* The same premiums, on similar conditions, will be given for Silk produced in the years 1818 and 1819.

## *PREMIUMS OFFERED FOR THE ADVANTAGE OF THE BRITISH SETTLEMENTS IN THE EAST INDIES.*

### INDIA PAPER FOR COPPER PLATE PRINTING.

200. To the person who shall communicate to the Society the best account of the process employed in India in the manufacture of Paper used in England for Copper Plate Printing, and known by the name of India Paper, together with an account of the materials from

which such Paper is made;—*the Gold Medal*, or *Fifty Guineas.*

Specimens of the Paper, not less than two reams, with samples of the materials in their raw or unmanufactured state, and satisfactory certificates signed by the Secretary of the Board of Trade of the respective settlement, to be produced to the Society on or before the first Tuesday in March, 1820, or 1821.

BHAUGULPORE COTTON.

201. To the person who shall import into the port of London, in the year 1818, the greatest quantity, not less than one ton, of the Bhaugulpore Cotton, from which Cloths are made in imitation of nankin, without dyeing;—*the Gold Medal.*

A quantity of the Cotton, not less than five pounds weight, in the pod, and five pounds carded, to be produced to the Society, with proper certificates, signed by the Secretary of the Board of Trade of Bengal or Bombay, on or before the last Tuesday in February, 1819.

ANNATTO.

202. To the person who, in the year 1818, shall import into the port of London, from any part of the British settlements in the East Indies, the greatest quantity of annatto, not less than five-hundred weight;—*the Gold Medal.*

A quantity of the annatto, not less than ten pounds weight, to be produced to the Society, with proper certificates, signed by the Secretary of the Board of Trade of the respective settlement, that the annatto is the produce of such settlement, on or before the last Tuesday in Feb. 1819.

TRUE COCHINEAL.

203. To the person who, in the year 1818, shall import into the port of London, from any part of the British settlements in the East Indies, the greatest quantity of true Cochineal, not less than three-hundred weight;—*the Gold Medal.*

A quantity of the Cochineal, not less than three-pounds weight, with proper certificates, signed by the Secretary of the Board of Trade of the respective settlement, that the Cochineal is the produce of such settlement, to be produced to the Society on or before the first Tuesday in February, 1819.

*N. B.* The Premiums from No. 199 to 202 inclusive, are all extended two years farther, on similar conditions.

## *BRITISH MARBLES.*

THE SOCIETY considering that it would be beneficial to the Commerce of the United Kingdom to bring the British Marbles into general use, and that the most effectual method of accomplishing their object would be, *for the present*, to make them more generally known in the Capital, have come to the following Resolution:

Resolved, That specimens of British Marbles be exposed in the Society's Rooms, in the Adelphi, for the inspection of the public, under the following regulations:

1st, That all the specimens be exact to a given size, viz. eight inches high, six inches broad, one thick, and polished on one face.

2d, That a book be kept, containing the number of each specimen, and describing the situation of the quarry, the name of the parish where situated, the distance of the quarry from a beaten road, and the distance of that road from water-carriage, with the name of the donor and proprietor. Any remarks on the qualities of the Marbles, or on the lime produced from them, will be gratefully received and preserved by the Society, as materials for future inquiries.

As the exertions of the Society can be generally beneficial only inasmuch as their views are seconded by the public, the Society request, that all proprietors of Marble Quarries will favour them with a specimen of the Marble, worked to the exact size above-mentioned, with the description of the quarry as above, that the same may be entered in the book to be preserved for the use of the public. By such arrangements, it is expected that the interest of the proprietors of the quarries will be promoted, and the use of British Marble much extended. A variety are already exhibited in the Society's Rooms.

# PREMIUMS AND REWARDS BESTOWED BY THE SOCIETY DURING THEIR SESSION, WHICH COMMENCED ON THE FIRST WEDNESDAY IN NOVEMBER, 1817, AND CLOSED ON THE 18TH OF JUNE, 1818; AND WHICH WERE DISTRIBUTED ON TUESDAY, MAY 26, 1818, BY

# HIS ROYAL HIGHNESS THE DUKE OF SUSSEX, PRESIDENT.

## IN AGRICULTURE.

1. *To Robert Haldane Bradshaw, Esq. M. P. of Worsley-hall, near Manchester*, for Reclaiming 294 acres of Peat Moss, *the Gold Medal.*
2. *To the Rev. E. Cartwright, D. D. Hollanden-house, near Tonbridge*, for Comparative Experiments on Manures, *the Gold Medal.*
3. *To Sir W. W. Wynn, Bart. M. P. Wynnstay, Denbighshire*, for Planting 845,500 Forest Trees, *the Gold Medal.*
4. *To R. Creyke, Esq. Dotterill-park, near Beverley, Yorkshire*, for Planting 164,560 Forest Trees, *the Silver Medal.*
5. *To Mr. J. Common, Denwick, near Alnwick*, for a Double Drill Turnip Sower, *the Silver Medal, and Ten Guineas.*
6. *To Isaac Espinasse, Esq. Chancery-lane*, for the Management of Bees, *the Silver Ceres Medal.*

## IN CHEMISTRY.

1. *To Ambrose Bowden, Esq. Navy Office*, for a method of Preventing and Curing the Dry Rot in Ship Timber, *the Gold Medal.*

## IN POLITE ARTS.

1. *To Mr. A. P. Harrison, Gloucester-place, Camden Town*, for an Original Landscape, *the Silver Palette.*
2. *To Mr. C. F. Tayler, Leadenhall-street*, for an Orignal Miniature, *the Silver Isis Medal.*
3. *To H. H. White, Esq. Old-square, Lincoln's-inn*, for a Copy of a Painting, *the Silver Medal.*
4. *To Miss J. T. Hamlyn, of Plymouth*, for an Original Painting of Game, *the Gold Isis Medal.*
5. *To Miss Maria Grant, Little Dean's Yard, Westminster*, for a Copy of a Drawing from Teniers, *the Silver Medal.*
6. *To Miss M. Mainwaring, Chichester Rents, Chancery Lane*, for the Copy of a Painting, *the Silver Palette.*
7. *To Mr. L. R. Grieves, Church-street, Soho*, for a Pen and Ink Drawing, *the Silver Isis Medal.*
8. *To Mr. J. D. Harding, Greenwich Road*, for an Original Landscape, *the Silver Medal.*
9. *To Mr. G. Gwilt, jun. Union-street, Borough*, for an Original Drawing, *the Silver Palette.*
10. *To Mr. C. F. Thatcher, Paddington*, for an Original Drawing, *the Silver Isis Medal.*
11. *To Mr. G. Gibbon, Sackville street, Piccadilly*, for a Drawing of the Townley Venus, *the Gold Isis Medal.*
12. *To Mr. J. S. Davies, Hackney*, for a Copy of an Engraving, *the Silver Palette.*
13. *To Mr. F. Langdon, Maida-hill, Paddington*, for a Copy of an Engraving, *the Silver Isis Medal*
14. *To Mr. W. Warman, Compton-street, Brunswick-square*, for a Copy of a Miniature, *the Silver Palette.*
15. *To Mr. H. C. Slous, Panton-street, Haymarket*, for a Drawing of the Elgin Theseus, *the Silver Palette.*
16. *To Mr. H. Edward, Percival-street, Goswell Street Road*, for a Drawing of the Townley Homer, *the Silver Medal.*
17. *To Mr. W. H. Davies, Plumtree-street, Bloomsbury*, for a Drawing of the Townley Homer, *the Silver Isis Medal.*
18. *To Mr. C. Rolls, Bayham-street, Camden Town*, for an Outline Drawing of the Farnese Hercules, *the Silver Medal.*
19. *To Mr. T. Engleheart, Bayham-street, Camden Town*, for an Outline Drawing of the Farnese Hercules, *the Silver Isis Medal.*
20. *To Mr. A. Poynter, Lambs Conduit-place, Foundling Hospital*, for a design

for a Post Office, *the Silver Medallion, in conformity to the Will of the late John Stock, Esq.*

21. *To Mr. C. H. Fowler, Millman-street, Foundling Hospital,* for a design for a Post Office, *the Silver Isis Medal.*
22. *To Miss M. A. Chalon, Beaumont-street, Devonshire-place,* for a copy of an Historical Painting, *the Silver Isis Medal.*
23. *To Miss B. A. Clarke, Finch-lane, Cornhill,* for a Copy of an Historical Painting, *the Silver Medal.*
24. *To Miss E. Wallace, Bath,* for an original Flower Piece, *the Silver Isis Medal.*
25. *To Mr. J. B. East, Grafton-street, Fitzroy-square,* for a Miniature, after Guido, *the Silver Medal.*
26. *To Mr. T. Taylor, Birmingham,* for a Model in Wax of her late Royal Highness the Princess Charlotte, *the Gold Isis Medal.*
27. *To Master S. Henning, Queen's-row, Pentonville,* for an Original Intaglio, *the Silver Palette.*
28. *To Master A. S. Henning,* for the Copy of an Intaglio, *the Silver Palette.*
29. *To Master J. Henning,* for the Copy of an Intaglio, *the Silver Palette.*
30. *To Mr. J. Marrian, Birmingham,* for a Medal Die, *the Silver Medal.*
31. *To Miss Ellen Durham, Hollywood-place, Little Chelsea,* for a Copy of an Engraving, *the Silver Palette.*
32. *To Miss L. A. Phillipps, Wandsworth-road,* for an Original Landscape, *the Silver Isis Medal.*
33. *To Mr. W. Plant, Fetter-lane,* for an Enamel Painting, *the Gold Isis Medal.*
34. *To Mr. T. Merrifield, Princes-street, Bedford-row,* for an Original Model of Figures, *the Gold Isis Medal.*
35. *To Mr. G. Mills, Hadlow-street, Burton Crescent,* for a Medal Die, *the Gold Medal.*

## IN MANUFACTURES.

1. *To the Widow of the late S. Brierly, Rochdale,* for his Stretch for Woollen Weavers, *Ten Guineas.*

## IN MECHANICS.

1. *To Mr. G. Prior, Howard's Green, City-road,* for a Machine to Prevent Accidents in Descending Mines, *the Silver Isis Medal.*
2. *To Mr. T. Lane, Stockwell,* for a Turning Lathe, *the Silver Medal.*
3. *To Mr. T. Lane, Stockwell,* for a Ruler and Quill-holder, for those who have lost one hand, *the Silver Medal, or Ten Guineas.*
4. *To J. Conolly, Esq. Suffolk-street, Charing-cross,* for a Portable Telegraph, *the Silver Medal.*
5. *To Lieut. W. Rodger, Royal Navy, King's Road, Chelsea,* for a plug for Raising Empty Casks, *the Silver Medal.*
6. *To Mr. James Jones, Holborn,* for improved pulley blocks, *the Silver Medal.*
7. *To Mr. C. Hall, High-street, Mary-le-bone,* for a Percussion Gun Lock, *the Silver Medal.*
8. *To Lieut. Shuldham, Royal Navy,* for a New Method of Ballasting Vessels, *the Silver Medal.*
9. *To Mr. J. Ramshaw, Fetter-lane,* for an Improved Method of Heating Copper Plates, *the Gold Isis Medal.*
10. *To Mr. T. Cook, Plymouth, Midshipman, Royal Navy,* for a Night Life Buoy, *the Gold Isis Medal.*
11. *To Mr. D. Ritchie, Clerkenwell,* for an Improved Method of giving Motion to a Pendulum, *the Gold Isis Medal and Thirty Guineas.*
12. *To Mr. J. Park, Portsmouth,* for a Mooring Block, *the Gold Medal.*
13. *To T. Grant, Esq. Plymouth,* for a Life Preserver in cases of Shipwreck, *the Gold Medal.*
14. *To Mr. J. Clement, St. George's Fields,* for an Instrument for Drawing Ellipses, *the Gold Medal.*
15. *To Mr. Moses Somerford, Wolverhampton,* for an Improved Door Lock, *Five Guineas.*
16. *To Mr. J. Heulon, Welbeck-street,* for a Door Spring, *the Silver Isis Medal and Five Guineas.*

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# PAPERS

IN

# *AGRICULTURE.*

## N° I.

## PEAT MOSS.

*The* GOLD MEDAL *of the Society was this Session presented to* ROBERT HALDANE BRADSHAW, *Esq. M. P. of Worsley Hall, near Manchester, for reclaiming* 294 *Acres of* PEAT MOSS.—*The following communication was received from him on the subject.*

Worsley Hall,
31st Oct. 1817.

SIR;

I TAKE the liberty of requesting that you will submit for the consideration of the Society of Arts, the following statement as applicable to the Premiums in Agriculture offered by them in 1817; trusting that on a review of the facts therein recited, I may be allowed to have some small claim to the distinguished honour awarded by Article 43, to such as shall have, to the satisfaction of the

Society, turned their attention to the Improvement of Waste Lands.

Towards the latter end of the year 1810, I purchased the Manor and Estate of Boothstown, situated within the township of Worsley, in the county palatine of Lancaster, and consisting of nine hundred and twenty statute acres, of which two hundred and ninety-four were rough and almost impassable moss, on an average six yards deep, very boggy, wholly uncultivated, and lying perfectly useless; its surface was covered with a coarse ling, and a variety of aquatic plants. Shortly after taking possession of this property, my attention was naturally directed to this unproductive portion of it, and thinking that the greater part, if not the whole, might be reclaimed and brought into a state of cultivation at a moderate expense, I determined on attempting it, and am now enabled to lay before the Society the successful result of my undertaking.

From the spongy nature of the moss, and the impossibility, in many places, of its bearing men, much less cattle, my first object was, to form and complete the roads delineated on the accompanying plan or map,* which I gradually effected in the following manner:—Two parallel drains, six feet wide at top, one at bottom, and three deep, were cut on each side of the intended line, which, on an average of the whole of the roads, may be set down as eleven yards wide; and the clods of moss taken out were used for the purpose of rounding them in the middle. This done, loppings and boughs, cropped from the trees and plantations near at hand, were placed crosswise upon the road, and a coat of rock, the refuse of brick kilns, and such other hard materials as could be procured, of about twelve inches in thickness, and four yards in breadth, was laid thereon from the centre each way, forming altogether

* This map remains in the possession of the Society.

a solid and excellent road. The expense was about eleven shillings per rod, and, as may be easily conceived, greatly facilitated the accomplishment of my ulterior views and intentions.

The next thing done was, to cut drains, six feet wide at top, one at bottom, and three deep (executed by bargain, at the rate of $13\frac{1}{2}d.$ per lineal rod, including levelling the same), in the directions and manner shown in the plan before referred to; care being taken to obtain as much fall for the drainage water as possible, and which will account for the roads not running in parallel lines from the main one; as, under other circumstances, would have been perhaps more desirable.

I had already bored for and found marl in the lands adjoining; and on subsequently boring in the skirts of the moss itself, I was so fortunate as to discover considerable quantities, so situated as to afford great facility in the operation of marling. The pits on the west and north sides were first opened, and the work began from these several quarters simultaneously, by means of iron rail ways, which were previously laid down for the purpose of conveying the marl by waggons across the moss to the different parts thereof; the plan will demonstrate how much has been reclaimed from 1811, to the present period, as well as the proportions improved in each several year.

The whole may be comprised in four lots, under five heads of produce, potatoes, beans, oats, meadow land, and pasture for sheep and cattle; and as each has undergone a process varying but little in its nature from that adopted in lot 1, and planted with potatoes, perhaps it will be deemed sufficient to give the items of expense attending such process, in that instance only.

The contents of this lot are ten enclosures, which were marked in 1814 and 1816, and lay so until this spring,

when they were dug and delved for potatoes; the whole expense of cultivation, from the beginning, and the produce of the present crop, being as under:

| | £. | s. | d. |
|---|---|---|---|
| Push-ploughing the surface, burning the same, and levelling per acre . . . . . | 1 | 13 | 4 |
| Marling with waggons, on a rail way (two waggons drawn by one horse) per acre . . | 14 | 3 | 0 |
| Delving in butts, each three yards wide, per acre . . . . . | 4 | 14 | 3 |
| Dry scrapings of the streets, from Manchester, &c. for manuring when delving, and covering the potatoes when set, 100 tons per acre, at 3s. per ton . . . . . | 15 | 0 | 0 |
| Potatoe-sets per acre, and setting the same . | 12 | 7 | 6 |
| Nicking out and opening the water ways between the butts, per acre. . . . . | 1 | 0 | 0 |
| | £.48 | 18 | 1 |

The produce has been sold, and amounted to 19*l*. 10*s*. per acre.

It may here be necessary to observe, that the potatoes, when gathered, are sold to a large body of labourers, employed in these and other works, including very extensive collieries under my superintendence in the neighbourhood, and when the crops are got, great attention is paid in keeping up the manure, marl and soil, at the same time mixing up all well together with the moss brought up in delving.

I next beg leave to call the Society's attention to that part of the plan, named lot 2, and comprehending eight enclosures. These lands having undergone operations similar to the foregoing last year, produced a very fair

crop of potatoes, and were last spring set with beans, at no greater expense than the following:

| | £. | s. | d. |
|---|---|---|---|
| Seed beans per acre 2 bushels, at 8s. 6d. per bushel | 0 | 17 | 0 |
| Sitting with sticks per acre | 0 | 10 | 0 |
| Opening the water ways, between the butts (rendered necessary in consequence of two butts having been laid together, round in the middle, when the former crop of potatoes was gathered last autumn, and which continued in that state until the setting of beans in the spring) per acre | 0 | 8 | 0 |
| | £.1 | 15 | 0 |

The produce of the above crop has yielded 17*l.* 10*s.* per acre.

After the beans are reaped, hay seeds are sown on the stubble, which never fail to produce excellent grass the following year. This and a succeeding crop will go a great way towards balancing the deficiency, say 13*l.* 13*s.* 1*d.* per acre, on the produce of the former crops of potatoes and beans, if not altogether defray the whole expenses of improvement, without taking into consideration the increased value of the land, which, from being entirely useless and unprofitable, may even at the present moment, be fairly rated as worth 60*l.* per acre.

Another part of the moss deserving particular notice from the different mode of its being brought into cultivation is lot 3, comprising eight fields, which, although giving less profits in the first instance, leaves the land more in heart for succeeding years, as meadow or pasture, from one crop only having been taken. It was marled in 1814, and ploughed during the last Autumn and Spring for oats

and clover, being manured with a set of street scrapings and soap waste; this method of course brings the land earlier into grass than the former one, and, from its better condition produces fuller crops of hay than when cultivated in the manner first described, and has been uniformly abundant. As the present, like that allotted to potatoes, is the first crop derived from the moss in its improved condition, every expense attending its improvement is here recapitulated.

| | £. | s. | d. |
|---|---|---|---|
| Push-ploughing the surface, burning the same, levelling and marling per acre, as more fully particularized in lot 1 . . . . . | 15 | 16 | 4 |
| Compost of street scrapings and soap waste; 25 tons per acre, at 10*s.* per ton. . . . . | 12 | 10 | 0 |
| Ploughing three times, scuffling, harrowing, &c. twice, with horses on pattens . . . | 6 | 10 | 0 |
| Five bushels of seed oats, per acre . . . . | 1 | 15 | 0 |
| N.B. The price of oats has fallen considerably, since the above were bought. | | | |
| | £.36 | 11 | 4 |

Produce of oats 6*l.* per acre.

The remainder of the improved moss (excepting the part marled in 1817, which will be delved and set with potatoes next Spring) is either meadow or pasture, and now bears a remarkably fertile appearance, supplying excellent herbage for sheep, and light cattle, such as small Scots, which thrive well on it. The enclosures throughout lots 1, 2 and 3, as well as those of the meadow or pasture land, are substantially fenced and planted with forest trees and quicksets, which look exceedingly healthy; and buildings for the purposes of husbandry, consisting of a barn, stabling, and a cart-house, together with a capital new

paved farm yard, have been erected since 1811, and form part of the moss farm, situated to the north.

It must be observed that some parts given in the plan, are, as yet, only in an unfinished state of cultivation; but I confidently trust that before the expiration of the two next years, the whole will have assumed the same altered appearance as that to which the annexed certificate bears testimony, and do equal credit to those who have hitherto had the executive superintendence and management thereof.

In an undertaking of such magnitude as that I have described, I am sure it will not escape the enlightened observation of the Society of Arts, that its accomplishment, as well with respect to harvesting the produce of the land, in its present state, as well as the earlier stages of progressive improvement, could not fail to have given constant occupation to a large class of labourers, artizans, and others, from which very considerable public benefit must have resulted; but more particularly so during the last Winter and Spring, when, on a monthly average, there were never less than from eighty to ninety employed; and that too, at a period when, from an almost total stagnation in every branch of trade, and consequent impossibility of obtaining work, the greatest distresses were experienced in this populous manufacturing district.

Thus, Sir, having endeavoured to put you in possession of all the information in my power to give, on the subject of the improvements made on a tract of uncultivated, useless waste, which, when the remaining seventeen acres and a half are completed will nearly amount to three hundred of excellent land, I respectfully take my leave, observing that, should my humble exertions to encourage and extend agricultural industry, as well as to furnish the means of employment to a large number of hands out of work, at a time of great national distress and suffering,

obtain the favourable consideration and notice of the Society of Arts, it will afford me the highest gratification.

I am, Sir,

*Arthur Aikin, Esq.*
*Secretary &c. &c.*

&c. &c. &c.
R. H. Bradshaw.

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## CERTIFICATE.

We, whose names are hereunto subscribed, do certify, that we have viewed and thoroughly examined the lands, crops, and improvements, consisting of two hundred and ninety-four statute acres (of which the accompanying is a correct plan), forming part of an estate, called the Manor of Boothstown, situated within the township of Worsley, in the county palatine of Lancaster, the property of Robert Haldane Bradshaw, Esquire, of Worsley Hall, in the same county; and do declare, to the best of our judgment and belief, that the annexed is a true statement of the process used in bringing the moss or waste land in question into its present condition, of the expenses attending the improvement and cultivation of the same, as well as the produce of the late crops, and (though last, and what, in our opinion, should not be the least estimated) of the essential benefit that has accrued to the neighbourhood by the constant employment it has given to so many labourers and others, during the late period of general distress, and which, from a stagnation in trade, was so severely felt in this very populous manufacturing district.

Given under our hands, this first day of November, 1817.

James Watkinson, *one of his Majesty's Justices of the Peace for the county of Lancaster.*

Robert Lansdale, *Churchwarden for the township of Worsley, in the Parish of Eccles.*

John Pickup, *Ditto Ditto.*

## N° II.

## BURNT CLAY.

*The* GOLD MEDAL *of the Society was this Session presented to the* REV. EDMUND CARTWRIGHT, *D. D. of Hollanden-House, near Tonbridge, for his experiments on the efficacy of* BURNT CLAY, *as a Manure. The following communication was received from him on the subject.*

SIR;

I OFFER myself a candidate for the premium, No. 46, to be given by your Society, under the head *Manures*.

For some years past, I have been in the practice of using soot and wood-ashes, as top-dressings, but never to much extent, from the difficulty of procuring them in any considerable quantity. In the Spring of this year (1819) I was enabled to obtain soot sufficient to top-dress between five and six acres; part pasture and part arable, after the rate of 50 bushels per acre; and wood-ashes sufficient for the same quantity of ground, after the rate of 100 bushels per acre. The prime cost of the soot was 9*d.* per bushel. But as I had to fetch it from some distance, I calculate the price of it, when brought home, at 1*s.* per bushel. The wood-ashes were $4\frac{1}{2}d.$ per bushel; but as they lay nearer home, I reckon the carriage at $1\frac{1}{2}d.$ per bushel. The expense, therefore, of top-dressing with each of these articles, was the same, namely 2*l.* 10*s.* per acre. The object of my experiment this year was, to compare burned clay, soot, and wood-ashes. With burned clay I top-dressed about seven acres, after the

rate of 20 cart-loads per acre, each cart-load being about 20 bushels. I must here observe that when I first began the burning of clay, I found it a very difficult and expensive business: but I have latterly contrived a method of performing the operation at a very cheap rate. It does not now cost me more than 9*d.* per cart-load, fuel included, provided the weather is not unfavourable. So that the expense of this manure does not exceed 15*s.* per acre.

The soil on which these top-dressings were applied, was a cold, wet, tenacious clay. The crops on which they were tried, were Swedish turnips, the common turnip, kohlrabi, turnip-rooted cabbage, potatoes, mangel-wurzel, barley and beans.

On the 15th September, I measured off 50 square yards of Swedish turnips, under each top-dressing, and 50 square yards, which had not been top-dressed. Their respective weights were as follows:

| | | *ton.* | *cwt.* | *lb.* |
|---|---|---|---|---|
| Burned clay . . | 580 lb. per acre . . | 25 | 2 | 20 |
| Soot . . . . | 546 . . . . . | 23 | 12 | 2 |
| Wood-ashes . | 398 . . . . . | 16 | 12 | 52 |
| No top-dressing | 235 . . . . . | 10 | 3 | 12 |

Laying the value of the turnips at only 5*s.* per ton (and they certainly are worth more) the burned clay exceeds the soot in value of crop per acre 7*s.* 6*d.*, by saving in prime cost 1*l.* 15*s.* total 2*l.* 2*s.* 6*d.* The superiority of burned clay over wood-ashes, is nearly 8½*d.*, to the value of which, if the saving in prime cost is added, the superiority will be 3*l.* 17*s.* 6*d.*

The superiority of burned clay over that which had no top-dressing, will, in money (deducting the expense of burning the clay) be 4*l.* 7*s* 6*d.*

I must here observe that the great disparity between the

turnips which were top-dressed, and those which were not, must not be attributed altogether to the fertilizing properties of the substances employed, but in a considerable degree to the protection they afforded the young plants from the depredation of the fly. This will appear by the subsequent experiments on the kholrabi, and the common turnip. The kohlrabi plants, destroyed by the fly, were re-placed from a seed-bed. As the transplanting was performed in a showery time, none of them failed. The common turnip was sown during the same favourable weather, and escaped the fly altogether.

On the seventh of October, I measured off 50 square yards of potatoes, top-dressed, with burned clay, &c. &c. The results were as follow:

| | *bush.* | *pecks.* | | *bushels.* |
|---|---|---|---|---|
| Burned clay | 5 | 0 | per acre | 480 |
| Soot | 4 | 3 | | 456 |
| Wood-ashes | 4 | 2 | | 432 |
| No top-dressing | 4 | 0 | | 340 |

On the fourth of November, the results of similar experiments on kohlrabi were as follow:

| | *lb.* | | *ton.* | *cwt.* | *lb.* |
|---|---|---|---|---|---|
| Burned clay | 160 | per acre | 6 | 17 | 26 |
| Soot | 138 | | 3 | 18 | 32 |
| Wood-ashes | 114 | | 4 | 17 | 30 |
| No top-dressing | 93 | | 4 | 7 | 48 |

In my experiments on Reynold's turnip-rooted cabbage, and on mangel wurzel, I was completely defeated: in the one case, the seed, which I had had by me for many years, had out-lived its power of vegetating; and in the other case (the mangel-wurzel), it had never acquired

that power; the cold wet season of last Summer not suffering it to ripen.

Having only half an acre of barley, I divided it into four equal parts. Not having conveniency in my small barn to keep the produce of each by itself, I kept an account of the number of sheaves that each part produced. When the whole was threshed out, I divided the grain that it yielded, which amounted to two quarters, into four parts, proportionate to the number of sheaves reaped from each division.

| | *sheaves.* | *b.* | *pks.* | *qr.* | *b.* |
|---|---|---|---|---|---|
| Burned clay | 126 | 4 | 2 per acre | 4 | 4 |
| Soot | 121 more than | 4 | 1 rather more than | 4 | 2 |
| Wood ashes | 117 less than | 4 | 1 rather less than | 4 | 2 |
| No top dressing | 84 | 3 | 0 | 3 | 0 |

It must be observed that the barley was sown in alternate rows with beans, so that, in fact, the space occupied by the barley ought not to be reckoned more than a quarter of an acre, as one half of the ground produced a crop of beans. Of the result of the experiment on the beans, I am not able to speak, as they unluckily, when put into the barn, got intermixed with others.

November the 7th. The result of the experiment with common turnip was as follows:

| | *lb.* | | *ton.* | *cwt.* | *lb.* |
|---|---|---|---|---|---|
| Burned clay | 296 | per acre | 6 | 7 | 54 |
| Soot | 292 | | 6 | 5 | 36 |
| Wood ashes | 293 | | 6 | 5 | 36 |
| No top-dressing | 276 | | 5 | 16 | 76 |

Why the result of this last experiment should vary so much from the preceding ones I am at a loss to conjecture. Had I not paid the most minute personal attention to every individual part of the experiments from their commencement to the final measuring off and weighing the produce, I might suspect, indeed, that my directions

had been deviated from or neglected, but as this could not possibly have been the case, the result of this last experiment must be set down as one of the many anomalies that are perpetually arising to baffle human ingenuity to account for.*

Of the experiments on grass land, I had no convenient way of judging, but by the eye. As far as the eye could decide, the burned clay was, without question, the superior; and the soot, as in all the other experiments, except the last, was evidently more powerful than the wood-ashes. It is singular that in the neighbourhood where I reside, the farmers hold soot in very light estimation, but have a very high opinion of wood ashes; an opinion which these experiments may tend to rectify. Burned clay, it will clearly appear by these diversified experiments, has the most decided advantage over the other two substances in every respect: its immediate effect is greater; its original cost is less, and in durability it admits not of a comparison. It is universally admitted, that wherever burned clay has been applied on a cold, wet, adhesive soil, it makes an immediate alteration in the texture of it, ren-

* In a subsequent letter Dr. Cartwright thus expresses himself: I have never been more puzzled than to account for the results of the experiments on common turnip. I think, however, that I can now account for the whole. During the hop-picking season, this country swarms with gipseys and vagabonds of every description, who subsist chiefly on pillage. They last year, *in a single night*, carried off nearly 40 bushel of potatoes out of a field of mine. It is not unreasonable to suppose then, that my turnips suffered by their nightly depredations in the same way. As they would not draw them indiscriminately, but would select the forwardest, it is no wonder the theft was not suspected at the time, as the ground would still have a uniform appearance though half the crop was carried away. I am fully satisfied in this conjecture, and so is my bailiff. What confirms it is this: In two other fields, where I grew the same kind of turnip, the crops were uncommonly good, though the land upon which they grew was by no means equal to that which I appropriated to my experiments.

dering it dry and friable, so as to admit of its being worked at almost all seasons. I gave a dressing of burned clay to a small piece of ground, between seven and eight years ago, the effect of which is visible to this day, and probably will be for some years to come.

Burned clay has been used as manure in Ireland with the greatest success for at least a century past; has been introduced into Scotland with equal success within the last ten years; and it is now beginning to get footing in England, where, possibly, this paper, should it be sanctioned by the approbation of the Society of Arts, &c. may help to accelerate its adoption. As soon as it becomes universally established, we may date a new, and indeed, a brilliant era in the history and progress of British husbandry. This is not said at random, but from a confident persuasion, in which the opinions of some of our best agriculturists will bear me out, that the judicious application of burned clay, on soils to which it is adapted, will in a few years double their present value.

I am, Sir,

*A. Aikin, Esq.* &c. &c. &c.

*Secretary, &c. &c.* EDMUND CARTWRIGHT.

P. S. I herein inclose Certificates respecting the different experiments detailed in this paper, excepting what relate to the barley. As no account was taken and written down of the number of sheaves by any one but myself, and the reaper's recollection failing him, I have no other evidence to bring forward but my own memorandum.

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## CERTIFICATES.

THIS is to certify that I top-dressed in the course of last summer, 1817, nearly six acres, the greater part of which

was arable, on Dr. Cartwright's farm at Hollanden, in the county of Kent, with soot, and the same quantity of ground with wood-ashes, of which upwards of two acres were arable, and about seven acres with burned clay, of which the greater part was arable. These top-dressings were laid on in the following proportions per acre, namely, of soot 50 bushels, of wood-ashes 100 bushels, and of burned clay 20 cart loads.

JOHN KING, *Carter to Dr. Cartwright.*

THIS is to certify that I measured off and weighed the produce of 50 square yards of Swedish turnips, of Kohlrabi and common turnips, of each respectively, top-dressed with burned clay, soot, and wood-ashes, and 50 square yards of each which had no top-dressing, and that the results, as stated in Dr. Cartwright's paper, which has been read to me, are correct.

JOSEPH BANHAM, *Bailiff to Dr. Cartwright.*

THIS is to certify that I took up and measured the potatoes, mentioned in Dr. Cartwright's paper, which has been read to me, and that the same is correct.

JAMES PAINE, *Gardener to Dr. Cartwright.*

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SIR; Dec. 24th, 1818.

IT IS with great readiness I inform you of the improved method I have adopted of burning clay. When I first began, which is now three years ago, I followed such printed directions as I met with in different publications on the subject. I never, however, was able to accomplish my object but at an expense greater than what I could have purchased stable manure for. I determined, therefore, to try if I could not burn it at a cheaper rate. After a variety of experiments, which it would be useless to

detail, I tried the following:—I had a trench made (having sufficient fall for taking off the water), about 20 feet long, three feet deep, and as many wide. At the upper end of the trench, and resting on its sides, a brick arch was turned, about 9 or 10 feet long, having openings for letting the fire through to the clay. These openings were made by leaving out half a brick at proper intervals. In the front of the arch is a strong wall two bricks thick, which has its foundation in the bottom of the trench. This wall, which is 2 feet wider than the arch, rises about a foot above it, through which there is a mouth to the arch about 2 feet wide. The whole erection will not require above 5 or 600 of brick, and no lime, except for the front wall. The arch will be best laid in loam or puddle of any kind.

In setting the kiln, care should be taken, especially at the commencement of the business, to lay the sods, or lumps of clay, hollow, that the fire may draw through freely. When the pile is about 2 feet thick upon the arch, the fire should be lighted, and a sod wall made round the kiln, which may extend about 2 feet wider than the arch, which will be supported in front by the brick wall. The sod wall need not be above 3 or 4 feet high. As the ignition proceeds, fresh clay must be added, still letting it lie as hollow as conveniently may be. When the heap is between 4 and 5 feet high, and burned through, the fire may be suffered to die out. Clay, however, may still be added for a day longer at least, and the more crumbly part of the clay may now be used. Two men at 2*s.* 6*d.* per day, and a boy at 6*d.* per day to attend the fire, in $2\frac{1}{2}$ days burned 35 good cart loads, the fuel consumed was 175 furze faggots, at 5*s.* per hundred, the expense therefore stands thus:

| | £. | s. | d. |
|---|---|---|---|
| Labour . . . . . | 0 | 14 | 9 |
| Fuel . . . . . | 0 | 8 | 9 |
| To which may be added a donkey and cart, two days . . . . . | 0 | 3 | 0 |
| | £. 1 | 6 | 6 |

I need not observe that the divisions of the arch, &c. are merely arbitrary. My farm being a very small one, small kilns answer my purpose. I mean to have two, that one may be at work while the other is cooling. I must further observe, that the consumption of fuel will of course be regulated by the state of the weather. Those who do not choose to go to the expense of a brick or stone arch, may make one of sod or spits of clay (but in this case they must be perfectly dry, or else they will not support the superincumbent weight). The centre for this kind of arch is thus made:—Lay four or five strong stakes across the trench, and upon these lay faggots in a circular form to build the arch upon. When the work is finished, the centre of faggots is set fire to. Though a trifling expense is thus saved in the first instance, a brick or stone arch will be found in the end the cheaper, as the clay arch must be renewed every time. A brick arch, if properly made, will no doubt last many years.

I am, Sir,

*A. Aikin, Esq.* &c. &c. &c.

*Secretary, &c. &c.* EDMUND CARTWRIGHT.

## N° III

## FOREST TREES.

*The* GOLD MEDAL *of the Society was this Session presented to* SIR WATKIN WILLIAMS WYNN, BART. *M. P. of Wynnstay, Denbighshire, for planting* 845,500 FOREST TREES. *The following communication was received from him on the subject.*

Wynnstay,
March 7, 1818.

SIR;

ENCLOSED I send you the particulars respecting a considerable plantation which I have made upon an allotment of mountain land, about three miles above Llangollen: should the Society deem it worthy of a premium, I shall feel myself much honoured thereby.

I am, Sir,
&c. &c. &c.
W. W. WYNN.

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## CERTIFICATES.

THIS is to certify, that Sir W. W. Wynn, bart. has planted one hundred and sixteen thousand five hundred and fifty oak trees, forty-seven thousand eight hundred ash, eleven thousand three hundred beech, sixty-five thousand seven hundred sycamore, nineteen thousand two hundred mountain elm, fifty-four thousand one hundred other elm, seventy thousand nine hundred birch, sixty-two thousand

four hundred and fifty Spanish chesnut, one hundred and ninety-nine thousand three hundred and fifty larch-firs, one hundred and fourteen thousand one hundred Scotch firs, fifty-five thousand nine hundred and fifty spruce firs, nineteen thousand one hundred silver firs, nine thousand Italian poplars, two hundred and fifty mountain ash, two hundred and sixty willows, and one hundred laburnums, on part of his estate called Voel Eglwyseg, in the parish of Llangollen, in the county of Denbigh, between the 24th day of June 1814, and the 24th of June 1815, on such lands as are not calculated for the purposes of husbandry, in consequence of being too high, rocky, steep, and uneven, to admit of being ploughed, comprising the upper part of a conical mountain, and chiefly a northern, eastern, and western aspect. . . . .

The above plantation is well fenced on every side, partly with a skirting of enclosures, and partly with an excellent quick hedge, guarded till the plants reach maturity by a strong dry fence upwards of two feet high. The whole fence on every side is constantly attended to and kept in proper repair by a person whose sole business it is. The trees have not hitherto suffered any injury from sheep or other cattle, and appear healthy, and to thrive in a surprising manner, considering the high and greatly exposed situation they are planted in.

Witness our hands this 12th day of March 1817.

WILLIAM JONES, *Minister of Llangollen, aforesaid.*

JOHN DAWSON, *Gardener and Planter.*

P.S. It is perhaps proper to state that beside the plantation above mentioned, Sir Watkin has planted in different other places in the same period, near one hundred thousand trees of different kinds.

JOHN DAWSON, *Gardener.*

I DO hereby certify that the trees planted by Sir W. W. Wynn, bart. on part of his estate called the Voel, in the parish of Llangollen, in November and December 1814, and in January, February, March, and April following, of which a statement was transmitted to the Society of Arts, &c. last Spring, are in a thriving and healthy state.

JOHN DAWSON, *Planter.*

I TAKE the liberty of stating that there were planted on the same mountain in November and December 1815, and in January, February, March and April following, 630,000 trees as per statement annexed, which are doing extremely well; viz.

| | |
|---|---|
| Oak . . . . | 80,000 |
| Spanish chesnut | 63,000 |
| Spruce firs . . | 102,000 |
| Scotch do. . . | 110,000 |
| Larch do. . . | 90,000 |
| Wych elms . . | 30,000 |
| Mountain do. . | 35,000 |
| Ash . . . . | 80,000 |
| Sycamore . . | 40,000 |
| | 630,000 |

JOHN DAWSON.

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Wynnstay,
April 9, 1817.

SIR;

IN reply to your request, I beg leave to state that the number of acres planted at Voel Eglwyseg, during the time mentioned in the certificate, were two hundred and six, 181 of which were planted in holes dug for the purpose, 15 inches wide, and 12 inches deep; the other part

was planted by cutting two slits in this manner ⊢ and inserting the plant at the angle.

The trees planted on the former quantity were three years transplanted, and the latter one year, together with a few two-year-old seedlings. The situation from 12 to 1,400 feet above the level of the sea.

The expense of planting the larger quantity is estimated at 70*s*. per acre; the other part cost 10*s*. only per acre, and is much the best mode.

The trees planted on the upper part are three feet apart, and lower down five.

The mountain elm is not the wych elm, growing much taller, and having a narrower leaf, being much superior in quality, throwing out no large branches. For farther particulars respecting this useful variety, please to inquire of Mr. W. Malcolm, Nurseryman, Kensington, from whom part of them were purchased, and the remainder from Messrs. Dicksons and Brothers, Edinburgh.

I am, Sir,

&c. &c. &c.

WATKIN WILLIAMS WYNN.

## N° IV.

## FOREST TREES.

*The* SILVER MEDAL *of the Society was this Session presented to* RALPH CREYKE, *Esq. of Dotterill Park, near Beverley, Yorkshire, for planting thirty-four acres with* 164,560 FOREST TREES. *The following communication has been received on the subject.*

Beverley,
Jan. 27, 1818.

SIR;

I HAND you a certificate respecting the land I planted for Mr. Creyke at Dotterill and Kilham, in the year 1813.

The land planted upon Dotterill Wold in one belt, is 14 acres, containing 4,840 plants on each acre, two-thirds of which are larches, and the remaining third an equal proportion of ash, elm, Scotch and spruce firs, and were regularly filled up by me in 1814 and 1815. The land planted in Kilham East Field, by me, for Mr. Creyke, in 1813, contains 20 acres of 4,840 plants on each acre, two-thirds of which are larches, and the remaining third an equal proportion of ash, elm, beeches, oak, Scotch and spruce firs, and were also regularly filled up by me in 1814 and 1815, when both contracts were executed.

I am, Sir,
&c. &c. &c.
GEORGE TINDALL.

*A. Aikin, Esq.*
*Secretary, &c. &c.*

Kilham, in the East Riding of Yorkshire,
Jan. 24, 1818.

I, RICHARD HOPPER, of Kilham, yeoman, certify that I know very well the plantation at Dotterill Park and Wold, in the said township, the property of Mr. Creyke, and planted by Mr. Tindall of Beverley, and that I have viewed the same within these few days, and that it is well fenced and protected, and that the trees are in a healthy and thriving state, and likely to be timber trees, and that the land upon which they are planted was open wold land, used for a sheep walk, and not proper for agricultural purposes.

RICHARD HOPPER.

Kilham, in the East Riding of Yorkshire,
Jan. 24, 1818.

I, RICHARD HOPPER, of Kilham, yeoman, certify that I know very well the plantation in the West Field at Kilham, the property of Mr. Creyke, and planted by Mr. Tindall of Beverley, and that I have viewed the same within these few days, that it is fenced and protected, and that the trees are in a healthy and thriving state, and likely to be timber trees, and that the land upon which they are planted was open wold land, used for a sheep walk, and not proper for agricultural purposes.

RICHARD HOPPER.

## N° V.

## TURNIP SOWER.

*The* SILVER MEDAL *of the Society, and* TEN GUINEAS *were this Session presented to Mr.* JOHN COMMON, *of Denwick, near Alnwick, Northumberland, for a* DOUBLE-DRILL TURNIP-SOWER *of his invention. The following communications have been received on this subject.*

Denwick, near Alnwick.
May 7, 1818.

SIR;

I REQUEST that you will have the goodness to present to the Society for the Encouragement of Arts, Manufactures, and Commerce, the following description, and the accompanying model of an improved Double-drill Turnip-Sower of my construction. I invented it some time ago, and it has been used by many respectable gentlemen and farmers in Northumberland, who are ready to bear testimony to its great utility in turnip-sowing. Whatever countenance the Society may be pleased to bestow on this my invention, will be gratefully acknowledged by,

Sir,

*A. Aikin, Esq.*
*Secretary, &c. &c.*

&c. &c. &c.
JOHN COMMON.

It is acknowledged by experience, that even the single drill is very difficult to hold on the middle of the ridge, and at all times requires a most active and steady person to manage it. But where the land is any way rough, it is

impossible for the most active to conduct a single drill properly, and the double-drill sowers which had been made prior to this improved one, are still more unmanageable than the former; for, being made all in a piece, and incapable of shifting of their own accord, where there is the least variation in the distance of the drills (a circumstance unavoidable by the most active and expert husbandman), the turnips are frequently sown on the side of the drills, instead of the middle, where they would receive the full nourishment of the manure; this circumstance must be obvious to every one who has walked through a turnip-field when fit for hoeing. It will be observed by the model, that this improvement completely obviates those difficulties, and thus contributes much to the excellence of the crop, each roller and sower being independent of each other, and shifting on the axle with the greatest ease, according to the variation of the drills. I trust that this explanation, imperfect as it is, will be sufficient to point out its superior utility and advantage, upon inspection of the model.

J. COMMON.

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MR. COMMON; September 2, 1817.

I HAVE great satisfaction in communicating to you my opinion of the great utility of the Double Turnip-sower, which you sent me, and which I have had a complete trial of.

It is curious to see it work: how it extends, contracts, and applies itself, of its own accord, like some living creature, to drills of any distance, let them be ever so crooked or irregular, which defect is always the case in a greater or less degree, especially when unskilful ploughmen prevail, but which is completely remedied by your

Self-shifting Double Sower: by applying itself to the tops of the drills, it deposits the seed exactly on the dung, an advantage which cannot be so completely obtained by any double sower heretofore in use.

I am, Sir,

&c. &c. &c.

ROBERT COWARD, *Farmer.*
ROBERT GIBSON, *Farmer.*
WM. MARSHALL.
JOHN EMBLETON, *Farmer.*
THOMAS BROWNE, *Farmer.*

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Links House, near Morpeth, Northumberland, April 4, 1818.

SIR;

HAVING seen your letter to Mr. John Common, dated March 30, agreeably to your wishes expressed therein, I have to inform you that in the Spring of 1814 I got of Mr. Common one of his Self-shifting Double Turnip-sowers, which I have continued to use ever since, in preference to those on any other plan.

During which time I have sown 86 acres of turnips, and that I fully intend to continue using the same in preference to any other, as above stated; and that the implement deserves that publicity which the approbation of the Society will confer on it.

I am, Sir,

*A. Aikin, Esq.* &c. &c. &c.

*Secretary, &c. &c.* ROBERT COWARD.

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Lesbury, 9th April, 1818.

GENTLEMEN;

HAVING signed Mr. Common's certificate respecting the utility of his Double-drill Turnip-sower, which I did

from a conviction of its being superior to any instrument of the kind now in use in this neighbourhood, I beg to add, that having used it for the two last years, in which time I have sown upwards of sixty acres with it, I find that whatever shape the drills are, it invariably sows on the top or centre.

I am, Gentlemen,
&c. &c. &c.
JOHN EMBLETON.

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SIR; Chillingham, 8th March, 1818.

UPON making inquiries respecting John Common's Turnip-drill, I find that he made the first of them about ten years since; it is therefore somewhat particular, that I should not have heard of it sooner, as Glendal Ward (in which I live) is by much the most extensive turnip district, and has larger farms on it than any other in the county, yet there is only one of those drills in it, and that was gotten only last year, by a young man beginning farming. The reason for this most probably is, that the plowmen in this county, as well as those in the adjoining counties of Scotland, set out the one-bout ridges at such exact, equal distances, that the two-row drills, which have been used here many years, deposit the seed exactly in the middle of the top of the one-bout ridges, and, of course, the farmers have not thought it necessary to get new and more expensive implements, as their old ones served all the purposes wanted. But in counties where this system of drilling turnips is only introducing, and where the ploughmen are not so accurate in setting out the ridges at equal distances, Mr. Common's drill, with two concave rollers moving laterally, I think, will be found very useful.

Mr Thomas Brown of Alnwick, a very ingenious mechanic, says, that he made one of them eight years since, on hearing that John Common had made one about two years before; and he believes that John Common was the first person who made them.

I am, Sir,
&c. &c. &c.
JOHN BAILEY.

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*Reference to the Engraving of Mr.* COMMON'S *Double-Drill Turnip-Sower.*

PLATE 1, *a a*, shafts.

*b b*, handle.

*c c*, two concave rollers, which, from their particular form, always traverse along the top of the ridge *d d*. These rollers do not occupy the entire length of the axle, and, being loose on the same, readily traverse on one side or the other, in order to accommodate the occasional differences of distance between two adjacent ridges, and thus to enable the rollers continually to move along the top of the ridges.

*e*, fig. 2, a sheave attached to one of the rollers, and revolving on the same center with them.

*f*, fig. 2, 3, a sheave attached to the same spindle that carries the barrels g, fig. 3, which contain the seed.

*h*, a jack-chain passing over the sheaves *e* and *f*, and communicating the motion of the concave rollers to the seed-barrel.

*i*, a spout to receive the seed from the barrel, and to convey it into the drill formed by the cutters *k k*.

*m*, a cord passing across the handle, and fixed at each end to a frame *n*; hence, by raising the handle, the frame

Mr. John Commons's double-drill Turnip sower.

Pl. 1.

Fig. 1.

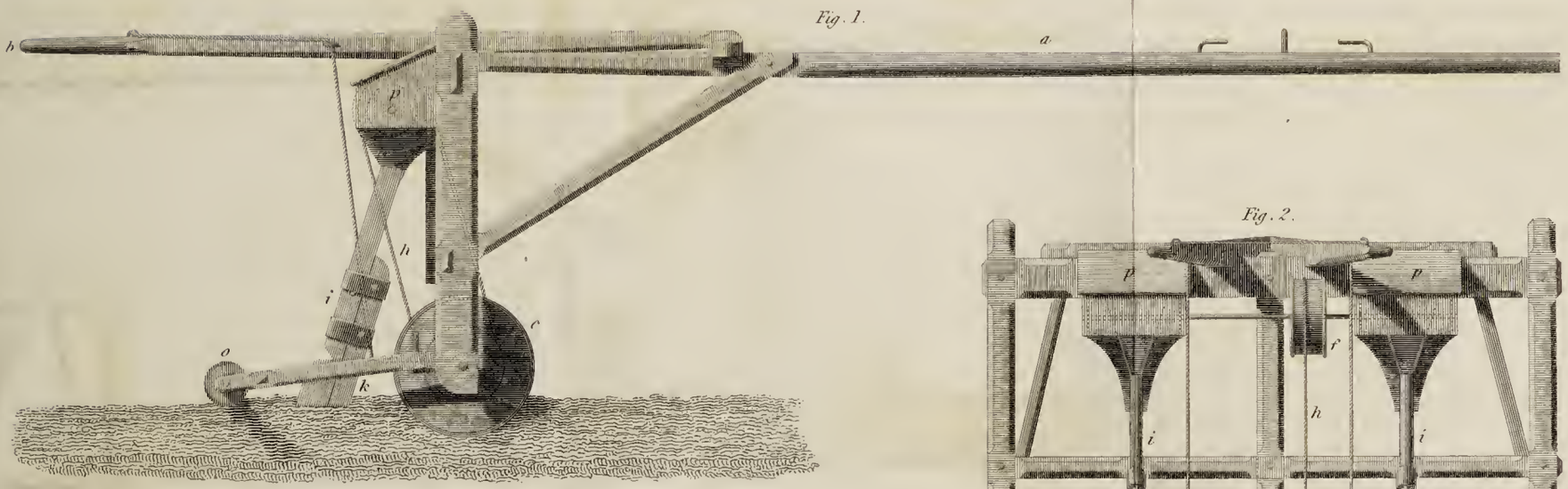


Fig. 2.

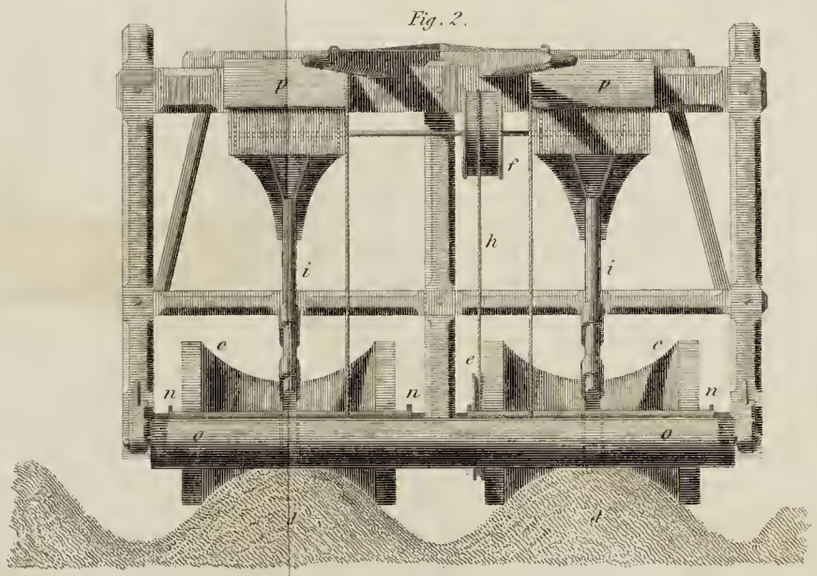


Fig. 3.

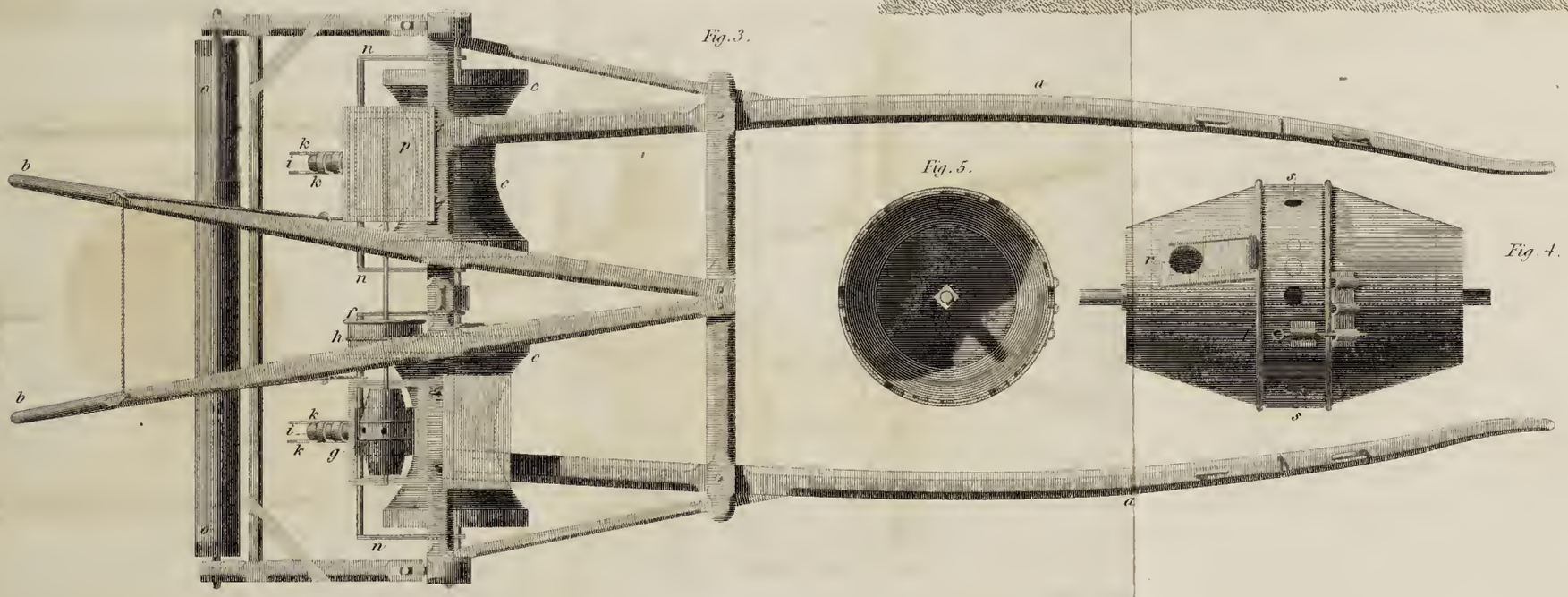


Fig. 5.



Fig. 4.




Drawn by J. Clement.

Edin.d Turrell Sculp.

is also raised, which last lifts the cutters out of the ground, and thus prevents them from being damaged, when the machine is turned from one furrow to another.

*o o*, a light cylindrical roller, to fill up the drills.

*p*, a box with a flap cover to contain the seed-barrel.

Fig. 4, the seed-barrel.

*r*, a hole, with a slide, through which the seed is poured into the barrel.

*s s*, a hoop, with eighteen holes in it, of three different sizes, corresponding with similar holes in the barrel through which the seed is delivered. This hoop is moveable, and by means of the pin *t*, may be fixed so as to leave uncovered either of the three sets of holes according as the seed is to be scattered near or more distant in the drills.

Fig. 5, a section of the seed-barrel, at right angles to its axis.

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## N° VI.

## MANAGEMENT OF BEES.

*The* Silver Ceres Medal *of the Society was this Session voted to* Isaac Espinasse, *Esq. of Chancery Lane, for his method of* Managing Bees. *The following communication was received from him on the subject, and Models of the Hives are preserved in the Society's Repository.*

Chancery Lane, Feb. 7, 1818.

The cultivation of, and improvement in, the management of Bees, being one of those subjects of rural economy which the Society have thought worthy of their attention,

and for the encouragement of which they have offered premiums, and they having at the same time signified that the claimant was expected to suggest his observations on the subject, I am induced (though engaged in very different pursuits), to offer the following Essay to their consideration. It is the result of experience, and of many years actual observation, not the speculation of a theorist, nor a compilation from the works of other authors on the same subject.

It is presented to the Society with no view to the pecuniary premium which they have offered, for did what I here submit to them give me any claim, or entitle me to such mark of their approbation, it should be restored to them as sought for with no other view, than to entitle me to have the honour of ranking among its members.

Conceiving that the views of the Society are not merely speculative, but directed to objects of practical improvement, I cannot but consider the number of publications respecting the generation of Bees, the prolific powers of the queen bee, the formation of their cells, and administration among themselves, as theories, ingenious and entertaining, but as in no wise tending to inform those who wish to keep this valuable insect, to make it most productive, or render it more generally useful. Several of these publications I have read, and the accounts in them of the different processes by glass hives, boxes, &c. the object of which is to save the bees, and take the honey, are open to these objections:—the descriptions in them are too complicated to be easily understood, and the necessary apparatus too expensive to be purchased, but by a few; and it must be recollected, that it is not from such, the supply of honey and wax necessary for our consumption is procured; as the number of those who indulge in these entertaining pursuits is small; it is the husbandman, the farmer, the gardener, and the cot-

tager, who by small contributions furnish the necessary stock of wax and honey.

In offering, however, my observations to the Society, I feel considerable difficulty, as my opinions on the subject of their premiums are much at variance with theirs; they seem to consider, that he performs a meritorious service to the public, who points out the mode of increasing the number of hives, and of preserving the insect. If the object of the Society is, to increase the quantity of wax and honey necessary for consumption, nothing is more fallacious than to suppose that it is *necessarily* effected by offering a premium for the greatest number of hives, without reference to their weight; though the assertion may seem a paradox, that an increase of hives does not necessarily produce an increase of honey. It is easy to cover the apiary with hives; if one is allotted to every swarm, cast, or colt, the numbers may easily be multiplied, but the quantity of wax and honey is lessened, as I shall demonstrate to the Society in the course of these observations.

I am no stranger to that complaint so continually in the mouths of those who are unacquainted with the subject, the cruelty of taking the honey, by destroying the Bees. Their fate is pathetically lamented as if they alone of all the creation were to be exempt from their contribution to the support of man; while such persons walk through a market, and look into a slaughter-house without emotion, they weep over the apiary in the month of September. No one can better love the insect than I do, nor more exert himself to shelter, to save, and protect it; addressing myself therefore with due deference to the opinions of the Society, who have thought the preserving the lives of the insects an object meriting a premium at their hands, I avow it to be my opinion that I consider the speculation of saving the Bees, and at the same time taking the honey, as impracticable, as well as unnecessary.

It is unnecessary for no insect generates faster than the Bee; as I have ascertained from actual experience, that in three weeks after a swarm had been hived, not only were the combs formed, but full of the maggot, the infant state of the Bee, and the combs will be found so filled with progressive generation from the month of March until October.

That it is impracticable, this observation will show; there is a certain relation in nature between the animal to be fed and the pabulum necessary for its support. The earth throws out but a certain quantity of flowers, and all that it does, do not afford honey for bees. Their numbers therefore must be limited by the food necessary for their support, and to suffer them to increase *ad infinitum* would be to defeat its own object, for famine would soon destroy those whom a mistaken mercy had spared.* The profusion and variety of flowers necessary for them, is found in few parts of the kingdom where I have been. And that pastures are to be sought for, other than those which surround the apiary in the beginning of the season, and before their numbers have been increased by swarms, is demonstrably proved by what is mentioned in some authors on the subject; that in Piedmont and Savoy, the bee-masters bring their hives down the rivers on rafts, anchoring in different places, where flowers are found in abundance for their food. Is this necessary from any other cause than from the want of sufficient food at home?

In a treatise of this description, intended for the perusal

* I am led to this observation, from what passed within my own knowledge a few years since. In the village where my house is situated, many persons induced by my example procured bees; they were too numerous for what was to feed them; more than one half of them died in the ensuing winter; and nearly one-third of mine were saved, only by being fed.

and information only of persons of common minds, who have no capacity for experiment, nor means of trying its effects; who are satisfied with the animal as they find it, as well worthy of their care and attention for the value of its productions, as conducive to health and many of the most useful purposes, I put by all the systems which speculation has raised, and the theories in which ingenuity has indulged itself. Used to Bees from my childhood, and for the last eighteen years the proprietor of a large stock, which I have watched, observed, and studied, and having directed my observations only to increase them, as far as they could be kept, and having protected them from every thing that could injure them, I address the observations contained here, to enable those who have none, and who may be disposed to keep them, to have the benefit of my experience, and those who have to increase their produce. This object I propose through the medium of this honourable Society.

I am aware that many of my observations will be found to be not entirely new, and equally so, that I shall have to controvert many received opinions, but I will state nothing which I have not tried, and for the effect and success of which I will not answer.

It requires no argument to establish the position, that where there is the greatest quantity of flowers, that is the situation best adapted for keeping Bees, but there are few where nature has not thrown out abundance. My house is situated in the village of Bexley in Kent; it is in the vale of Cray: Dartford heath is within a mile of it to the East, and Bexley heath two miles and a half to the North-west. I mention these matters with respect to situation, as heaths are supposed to be peculiarly productive of pabulum for the Bees, as affording in abundance the blossoms of the heath, furze, and wild thyme. The situation in that respect is a matter of primary consideration.

Those who are unacquainted with the insect, suppose that he possesses the fee simple of every flower, and that the whole regions of that description are devoted to his use. It is very far otherwise; and when poetry makes it light upon a rose and inhale its sweets, the truth is, that it never sucks it at all, or many other flowers; in fact, all whose cups are so deep, that its sucker cannot reach the bottom of it, where the honey is deposited. He, therefore, who wishes to keep Bees, must not rely upon every flower as furnishing support to his apiary; he must rely only on those which are shallow and small, or which expand widely in the leaves, so that the Bee can get to the bottom of the flower; neither must he rely wholly on the produce of the fields, meadows, pastures or heath but make his garden, or its borders, a separate plantation for such herbs and flowers as are fit for their use. For this purpose nothing I have found so grateful to the Bee, so easily propagated, so fruitful in produce of flowers, and so delightful in its flavour, as lemon thyme. It ornaments every part of my garden; and as it flowers in the beginning of August, and the honey derived from it is last deposited in the cells, it gives a flavour to all the honey which before had partially filled them:

——— redolentque thymo fragrantia mella.

VIRGIL, GEORGIC 4.*

The common thyme, winter savoury, and mignionette, I have also found greedily sought after; and as they blow late, are therefore valuable.

In the garden, as affording food for Bees, I must much recommend large plantations of gooseberries, currant trees, and raspberries.

Few of the ornamental flowers of the garden, as the

* I cannot help remarking here, that almost every observation in that delightful book, the Georgics of Virgil, I have found verified from my own experience.

ranunculus, anemone, pink, or carnation afford any pabulum for the Bees; and as for the tulip, I am induced to think that it possesses some quality injurious to them, from the following circumstance: In the month of May, 1817, having gone down to my garden, when the tulips were in blow, and looking into the body of the flowers for those which were well coloured, I observed a dead bee in almost every one of them, and in some two. This led me to examine nearly the whole of my beds, and there was scarcely any flower which did not exhibit the same appearance.*

The blossoms of the first-mentioned shrubs afford to them the earliest flowers, particularly the gooseberry; and the cupidity with which they suck them, presents the image of a sailor on his return tasting fresh meat and vegetables, who during a long voyage had fared on nothing but salt provisions. The blossom of the turnip is also very useful at that season of the year, as it furnishes both wax and honey in abundance.

I do not pretend to enumerate all the flowers which afford food to Bees, the general descriptions I have already given: those from which mine have principally drawn their support, are the white clover and the blossoms of the lime tree, and for wax, the blossoms of the furze and broom; it is the farina collected from these, that repairs the cells that have been tapped for their food during the winter: proximity therefore to these sources of support, is a very desirable circumstance in the formation of an apiary, the benefit of which I fully experienced in the

* From what cause this proceeded I have not been able to ascertain, unless from some deleterious substance which the insect might have imbibed from the flower; apprehending, however, that it might have been caused by the inability of the Bee to escape from the depth of the flower, I took a few bees from a hive, and put them into several very deep flowers, but they all got out, and flew away without any difficulty.

course of the summer of 1816. The lime trees which usually blossomed about midsummer, did not fall into bloom in that year, until late in July; at Midsummer the old hives are preparing, or have just cast swarms, and the combs in the new are not in a fit state to receive the honey; but in the late season of 1816, when those trees went into blossom, in every hive the combs were formed, and were in a state to receive the honey from the flower. The beautiful and rich grove of Mount Mascal, near Bexley, composed entirely of lime trees, furnished pabulum for millions, and all the Bees which then left their hives, I observed in thousands to take that southerly direction which led to it; the consequence was, that all my hives which until that time were uncommonly light, from the effect of an unfavourable season, in a fortnight's time were amply filled with honey.

The next object, in order to increase and improve the apiary is, attention to the hives used, and the mode of hiving the swarms. There is no prejudice which I have had more to combat with, than the using of large hives, that is, the use of hives without any attention to the proportion they bear to the swarms to be put into them. In Kent they are partial to hives nearly two feet high, and as large in diameter: they seem to consider, that the hives cannot be too large, and that it is of no importance whether the loaded and wearied insect is to drag his burthen up two feet of the side of the hive, or one; or whether the hive is to be wholly, or only partially filled with comb; both are of the utmost importance. I have uniformly observed, that Bees never work well, unless the hive is full,* and when, after all their labour, they find it empty, it is cold and uncheering, and they work with no

* In hiving the swarms, therefore, this must be attended to with particular care, that the hive be proportioned to the swarm; if it is too small, they will lie out in clusters on the board, and not work,

spirit. I therefore always endeavour to have a swarm fill the hive, when first hived, to within two or three rims at the bottom; and so necessary do I consider it to have the hive full of Bees before they begin to work, that I add to a small swarm either another, or a cast, and put two or three casts together, till a proper proportion of Bees is had; this is done with the greatest ease, by spreading a cloth on the ground, and striking the hive which contains the swarm to be added quickly and sharply on it, when the swarm will fall in a cluster on the cloth, and then quickly covering it with the hive, which is to be re-inforced with the addition, those on the cloth readily ascend, and fraternize without difficulty with the others; by these means a strong hive is formed, well filled with Bees, and they work with spirit; the hum of the many round the door, seems to rouse and cheer the rest; whereas, if the hive is weak of Bees, the want of vigour and spirit is visible. It is this circumstance which has induced me to offer that observation which I before made, respecting the number of hives of Bees, as making that a circumstance of reward; if every cast is hived, you have a numerous apiary, but I never had the good fortune to get an ounce-weight of honey out of a cast in July, which is the usual month for such swarms; I have, therefore, added them together, and often three into one hive, and they have worked cheerfully.

But the size and make of the hives is not the only matter to be attended to; the warmth arising from the thickness of the straw composing them, and the sweetness of it, are also deserving of much consideration. In all the hives which I have had in Kent, the rolls are thin and

having no place in which to deposit what they gather; if it is too large, and of course in great part unfilled, when the Bees come home they find the hive empty or cold, and work no longer with industry and spirit.

hard, and little attention is paid to the colour or sweetness of the straw; the consequence of which is, that they are cold in winter: I have, therefore, procured the hives which I use from Chelmsford, and Hertford, where the rolls are thick and not so hard, and the shape well proportioned and handsome. The shape which I prefer, is low, wide, and pointed at the top. Bees begin to work near the top of the hive, and work downwards; and as the combs approach the bottom, their labour is diminished. The board on which the hive is placed should be of well seasoned elm, of the thickness at least of an inch, as it will otherwise warp with the heat of the sun, and when every part of the bottom of the hive does not touch the board, vermin, such as ear-wigs, snails, &c. get in, and from the moment such unwelcome guests intrude into a hive, the Bees become discontented, and no longer apply themselves to work with vigour.

The bee-house is the next object of care. I consider mine as the best ornament of my garden; on an adjoining seat, most part of my day is spent in contemplating the activity and busy industry of these valuable insects; and in fact on the master of the bee-house being himself fond of the pursuit, great part of the success of keeping them depends: they must be watched during their time of swarming, and the attacks of their enemies must be warded off, for of these they have not a few. There are but two aspects in which the bee-house should be placed; the South, or some point towards it; and the East. I have in my principal apiary two houses, each containing eight hives; the one fronting the East, and the other the South; I have endeavoured to ascertain in which of them the Bees throve best, but in that respect I could find no difference. I however prefer the Southern aspect, as it enjoys the benefit of the Winter sun, whose warmth and effect in keeping the house dry, is of infinite consequence;

this leads me to the most decisive dictum on the subject, that it is essential to the thriving of Bees, that they should be kept sheltered from damps and wet, in Summer and in Winter; as, unless they are kept dry and warm, they will not work. Turn up an unsheltered hive on a rainy day, in the midst of Summer, a drousy hum announces their torpor; but if sheltered, so that the chilly effect of the rain has not reached the interior of it, the moment the atmosphere is cleared, and a glimpse of sunshine is seen, they will be observed to issue from their hives to work, as alert as if not a single drop of rain had fallen.

The absolute necessity of warmth during the Winter to the preservation of Bees is, independent of what has been already observed, the best answer that can be given to the possibility of taking the honey without destruction of the Bees. If the honey is taken, the combs must be taken too. What is the effect? The hive becomes empty; there is no exclusion of cold, from the circumstance of its being filled with combs: there is no resting place for the Bees, who are sheltered in the intervals, and some food is derived from the bee-bread and wax which is taken away. They do not live in Winter clustered as in a swarm, but are dispersed over the combs, and either feed on their appropriate cell, or what the combs contain. How, therefore, a swarm deprived of combs is to live in that cold, inactive, and unprotected state, I cannot conceive! Without food they cannot exist; the quantum to be administered, is not easily ascertained, and it is attended with much trouble; and though we well know that ingenious glass appendages have been filled with combs, such as the shop of Mr. Wildman exhibits, how is the cottager to procure this costly apparatus, and how to attend to it? for except by such means, ingenuity has never suggested any mode, nor speculation glanced at its practicability. If you mean to carry your hives through the winter, you

must give them their natural comfort and support; you must leave them their combs and their hives, and liberty to follow that mode of living which nature has pointed out to them.

Every bee-house should therefore be constructed of sufficient depth, that the hives may be brought forward, or pushed back, as the weather serves. In summer they cannot be brought too far into the light and heat, which rouses them into life, and stimulates their industry; nor in Winter be too far removed from the external wet and cold.

My two bee-houses are sheltered on every side by hedges, except towards the South and East. The hedges to the North and North-east are beech, which are kept closely clipped. No trees should be planted in the front, as that keeps off the sun, whose light and warmth are the great stimulants to their working. Six hives are, in my opinion, enough for each house, and the houses should stand at some distance from each other; the reason is, that when the Bees swarm, the buzz of those which rise first, is apt to induce the other hives to swarm also, and two good swarms often unite; but when they do so, they should be put into a hive proportionably large. The bee-house opens by folding doors at the back, by which every hive can be easily got at for any purpose required; the places in the front being made too narrow for a hive to be taken out there; the back may be secured from thieves by locking, or nailing up the doors during the winter: the floors should be made accurately level, for the purpose of feeding the Bees, if necessary

To the construction of the bee-house it is indispensable, that free access should be at all times had to the hives, to take them out when necessary. For this purpose, the doors at the back of the bee-house should open, whether it be to take them in Autumn, to weigh them at that time,

to ascertain their ability to support themselves during the Winter, to plaster them to the board to exclude the cold or wet, or to destroy any vermin that may be lodged in the house, or under their boards, all which matters must be attended to. Previous to shutting up the bee-houses for the Winter, the hives should all be taken out, and the whole interior carefully swept, when infalliby there will be found a plentiful collection of those insects whom the approach of Winter drives into their hiding places, and who seek for shelter in every cranny of the bee-house; snails, earwigs, and spiders are of this description; and that mice will also seek for shelter in the same place, and in the hive itself, I had this demonstrable proof.

On leaving the country in October 1809, among others, I left my oldest hive of considerable strength. In the beginning of the Spring, I observed but few Bees come out to work, and a general torpor seemed to pervade it; on turning it up, having before just lifted it on one or two occasions, I observed one half of the hive filled with beech-leaves (a beech-hedge forms one side of my apiary); upon examining it I found that the back of the hive had projected beyond the board, through which a mouse had entered: the Bees had retired to one side of the hive, and he had taken up his Winter quarters in the other. He had made his nest with the decayed beech-leaves, and he and the Bees had lived joint-tenants of the hive during the whole season. I removed the broken combs, and all the remains of his dwelling; the Bees seemed to recover new life; the hive was restored, and though it did not swarm the succeeding year, it became one of my best, and continued so for many years after.

Birds will be found enumerated in every publication on the subject of Bees, as their enemies; but I have found that there are but few birds destructive to the apiary; most of those which are so represented I have found are those

who come to feed on the dead Bees or maggots, which are thrown out from the hives, and though the swallow

" ———————Procne, manibus signata cruentis,"
VIRGIL,

is reckoned among the chief, I have observed that the most destructive is the bird called the house lark, a small ash-coloured bird, of the size of a tit-lark, and next to it, the tom-tit; these should, therefore, be destroyed whenever they present themselves where Bees are kept.

Of the insect tribe, there are many inimical to Bees; of these the moth is the most deadly; these insects are among the smallest of the genus, and are of a light whitish brown; they are remarkably active in their motions, and are seen running with great quickness round the hive, watching their opportunity to enter, which, when permitted to do in any number, the combs become the depository of their eggs; the top is filled with silky film; the bees are expelled; and the combs, when torn, resemble paper: these should be carefully watched and destroyed whenever they appear, for when once they enter a hive and breed, the loss of the hive is inevitable.* Spiders also, though but in a small degree destructive, interfere much with, and obstruct the working of the Bees without, by drawing their webs across the recesses of the apiary; this is however in Summer and Autumn only. They are very easily destroyed, by going out at night with a candle, at which time only they are

* Mr. Mills, in his treatise published by order of the Society, says, " the moths break the combs to pieces !" He could never have seen a hive which the moth had attacked: they are the feeblest of all insects, and incapable of breaking the combs; the effect of the attack of the moth is as I have described it. I never had but one so destroyed; but such is my opinion of the certain and destructive effect of the moth in hives, that it is sufficient for me to condemn a hive, and take it in the ensuing Autumn, from which I have occasionally seen a moth come out, or into which this insect has entered.

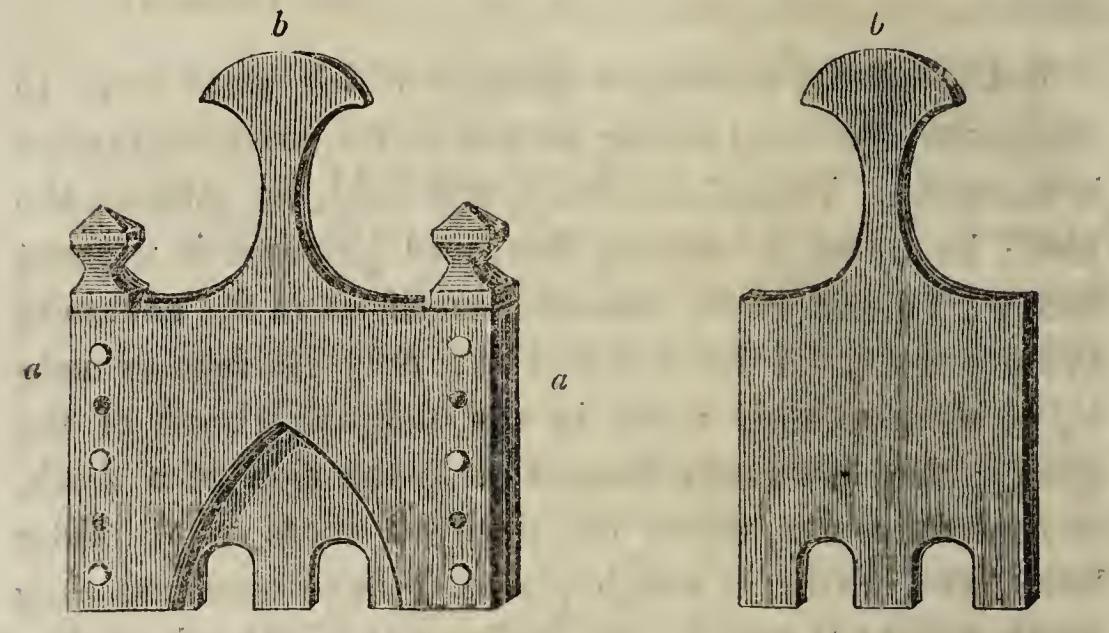
visible on their webs in the centre of them, and are easily taken by the hand and destroyed. These are the insects which Virgil points out—

> ———dirum tineæ genus, aut invisa Minervæ
> Laxos in foribus suspendit aranea casses.
>
> VIRG. GEORG. 4.

But of all the numerous enemies which Bees have to encounter, the most daring as well as the most destructive is the wasp. Rapacious, lively, and bold, he attacks the hive; he enters it without fear, and plunders it without mercy; to them many hives fall sacrifices in the course of every season. I have found the only efficient remedy is, to destroy their nests in the neighbourhood of the apiary; they are easily discovered in the side of a ditch, or near the water, where the decayed roots of the alder have left a cavity, in which places I have observed they much delight to breed; this is done at night, when they have all returned to their nests, by putting port-fire into their holes, or by burning straw on them; their nests, however, are not discovered until they have become numerous, and so attract observation by their flight, directed in numbers to a particular place; and before they are so discovered, they commit great and destructive devastation among the hives. I have uniformly closed the entrance of my hives by the means pointed out in the following drawing, where the Bees enter the hive by two small doors, sufficient only to admit a single Bee at a time.

After trying the common experiments of hanging up bottles of honey or sweet liquor near the hives, I found I lost as many Bees in those as I destroyed wasps, and it therefore occurred to me, that the best mode of securing the hives would be to narrow the doors while the wasps were out, or on the wing, by some expedient which at other times would allow the Bees their full scope of exit

and entrance. The following is my invention, and it has answered admirably, not for the purpose only of enabling the Bees to defend themselves from the wasps, but to shut them up during the Autumn and Winter; during the Autumn, to keep out the vermin, and in Winter to keep them warm,* yet give them air. This I put on the hives




early in August, as I by these means can give them more or less room to work, at the same time that I thereby exclude the entrance of every insect whatever; and to this early closing up the doors, but with a power at the same time of giving them full liberty to go out in any number, by lifting the slide, I attribute much of my success in the preservation of my stock hives, as their stores are left untouched, and they are kept dry, and all offensive insects, such as snails, moths, &c. are thus excluded.

* The drawing *a a*, represents two small pieces of wood about an inch and half long, about the sixth part of an inch broad, and of the same thickness; there is a groove in each, to receive a sliding piece of board *b*, about an inch and $\frac{1}{4}$ wide, in which are cut two small doors, wide enough to admit one bee at a time only. The pieces of wood *a*, are fixed on each side of the door cut in the hive itself, and fastened to the hive by two large pins; the piece of wood *b*, is then fixed in the two grooves, and is raised or put down at pleasure.

There are four periods or seasons at which Bees are to be particularly attended to. The first I consider to commence from the earliest bloom of the willow, and blossom of the gooseberry. It has been recommended at this time to lift the hive, and sweep the board, as the floor of the stool will be found covered with the dross of wax, which was what closed up the combs at the beginning of Winter, and when the cell was tapped for use, the wax would fall to the ground. I have never adopted that practice, for this reason, that to do so, the hives which had been plastered close to the boards during the winter, must necessarily be lifted from them, and the cold thereby introduced, which, at that season, I think would do more injury to the Bees, than any benefit which they would derive from taking away the loose wax from the board. If at this season they appear brisk, and issue from their hive in numbers, let no feeding on any account be allowed. It dulls their early activity and industry by their finding at home what they would otherwise gain abroad; and the honey drawn from the flower gives them a more healthful activity than they could have from any feeding; but if a hive is observed when struck, to emit a dull and heavy buzz, and if the Bees do not issue in any numbers, it may be of service to feed them, but scantily, and merely to give them strength to go abroad. From this time, until the period of swarming, they require some little attention; if the season is open, dry, and mild, in fact none; but if May should be wet and cold after the first swarms are cast, so that they cannot work, they must be attended to and fed, as they have no support from within, or they will perish.*

During the Summer the only attention requisite is to

* In the last year I had a swarm on the 17th of May; soon after, the weather became very unfavourable, and continually wet. I was obliged to feed them for a fortnight; very many died, but the survivors repaid my care, and when the weather cleared up began to work. At the end of the season, they gave me a hive of near thirty pounds weight.

watch the hives which show any indication of swarming, to take care that none go off.

As I do not profess to give full and perfect directions as to every matter connected with the hiving of the Bees, I content myself with recommending it as essential to the hiving of good stocks of Bees that the swarm, when hived, should nearly fill it, and if it does not, to add to it another swarm or cast, so that it shall fill it; the reason for which I have already given.

I now come to the season when the honey is to be taken, a task never undertaken without reluctance, nor executed without regret. When from the failure of the flowers, little or no addition is made to the stock of the hive in wax or in honey, and I calculate on none after the middle of August, having ascertained, from observation, that to be the fact, I consider that that is the proper period to take those hives which are too weak to get through the winter. This only reconciles us to the taking of them, for if not then done, a slow and lingering death by famine awaits them, their industry not having given them provisions for the season. I therefore begin to take my hives in the middle of August, by which means the honey runs more readily from the combs; the refuse, when thrown out, affords food for the Bees who remain, and there are fewer competitors for whatever pabulum the Autumn flowers afford.

The honey when taken, in order to be pure, fragrant, and well flavoured, must be such as flows spontaneously from the comb, cut into a hair sieve transversely when the hive is taken; left to flow through the sieve into a vessel beneath, and never squeezed, or the running of it forced by heat, and after it has so flowed through the hair sieve, it should be again strained through a finer one, so that not a particle of wax should mix with it, which creates a fermentation, and spoils the honey.

Honey, however, so prepared, by flowing from the combs, always becomes saccharine, but if the hive itself is kept, and the combs taken out as wanted, the beautiful and transparent honey will preserve its clearness, purity, and sweetness for at least a year.

I have until the last season, which was so unusually late, always considered, that Bees add little to their store after the first or second week in August; at this period, therefore, and for the ensuing month, much attention is required, to protect for them what they have acquired, as well from the depredations of wasps, the most destructive plunderers of their stores, as from the spoliation of each other. When an old hive has the unconsumed honey of former years in any quantity, in addition to what the present year has given, and the number of Bees is small, it is astonishing to observe how soon the weakness is discovered, and that hive is marked out as a prey to its neighbours.

The constant buzz that is round it, caused by Bees flitting round the door, and on their attempting to light being attacked by those on the stool, who are guarding their magazine, is an infallible sign and direction, that that hive is marked for plunder. On these occasions I have closed up the door to a very small entrance, and I have covered the front with a cloth; it has given only a temporary suspension to complete pillage, for nothing will save it or deter its assailants from their object. The hive is attacked by numbers, overpowered, and all their honey taken and carried away. Finding, therefore, the absolute impossibility of saving from the pillage of its neighbours, a hive rich in honey, but poor in Bees, and unequal to its defence when its weakness is discovered; I uniformly take it, considering that it may be useful, and save other hives which I might be disposed to take, from a mere trial of their weight, but in which the number of Bees was considerably larger.

I am now arrived at the last period of my tract, but not the least important, the judgment to be pronounced on such as are to be kept for stock hives; either relying on their acquired stock of honey, or such as are to be brought through the Winter by means of feeding, and what is necessary for bringing them through that season; on this much depends; but whatever hives are selected for that purpose, they should be closely plastered with lime to the stool; this contributes to their warmth, to the exclusion of vermin and insects, and if any water falls on the board, it does not reach the hive, which would otherwise become rotten and damp at the bottom; but when plastered round and up to the door, there is no entrance but through the two nicks in the slider. The front of the bee-house should be covered with board or oil-cloth, the hives pushed back, whereby they become darkened, and the bees less disposed to go abroad in Winter. If the number of hives is so great, that any given number may be selected, that selection depends on the weight of the hive, and the heaviest should be kept for stock, taking care, however, not to be decided by it only, but to endeavour to ascertain whether they are also strong in numbers: this can be known from having observed them out at work in Autumn, or by throwing the loose combs of the taken hives from whence the honey has flowed on the grass before the bee-house, from whence they will issue in great numbers to suck the refuse honey remaining in the combs, and they may be then watched on their return to the hive, and their numbers calculated. This attention to the number of Bees, as well as to the weight of the hive, is a matter of observation indispensably necessary, and on which every thing depends. It often happens that a hive heavy in honey has overswarmed itself, and the number remaining in the hive is small, such is perfectly unfit to be carried through the Winter. I have always weighed my hives at the close

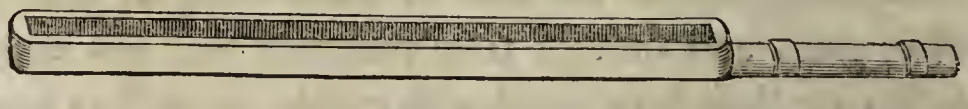
of Autumn, not by guess, but accurately by the scale and weights; I weigh them with the board on which they stand, having before ascertained pretty nearly the weight of the stand. If the hive weighs twenty-five pounds, it will safely get through the Winter without feeding; I have had some have gone through it which weighed twenty-two or twenty-three pounds only; but upon these without feeding, I cannot absolutely decide on their abilities to pass the months of Winter and the early part of the Spring. But with the aid of feeding, it is perfectly easy to bring any hive through the Winter. And here I beg leave to give the most decided contradiction to any author who has treated it as an idle, useless, and almost impossible expedient to save such a hive during the season. Many have done so, and many such assertions I have often heard made, but from which I totally dissent, and from repeated experience am enabled to contradict them. I have had many supported by these means during nearly the whole Winter, and those at the ensuing season have thriven out of measure, and become my best for the ensuing year.

It frequently happens, that in a late and wet season, the swarms come out in the latter part of June, and also numerous, strong, and large casts of the same description; they have not time to complete their store of combs and honey, but they are valuable for their numbers and their future promise; their industry only enables them to half fill their hives, and gather a support for a few Winter months. Nothing is of more facility than to bring those hives through the Winter by feeding, and when that is done, the remaining half of the hive is filled early in the succeeding year, and though they probably will not swarm, from having their hive to fill with combs, as well as honey, I have always found the quantity of the latter to be consi-

derable, and the number of Bees great in proportion; their attention is undiverted by throwing out swarms; their brood is employed at home, in what, if hived in a new dwelling, they would be called upon to do, filling it with comb as well as with honey.

For the effect of this I can answer. It has been done by me repeatedly for many years back, particularly at the commencement of this my favourite pursuit; and so far am I from thinking the feeding of Bees to be a useless and unavailing attempt, that I have, without deviation, year after year adopted it, beginning the feeding earlier or later according to the weight or strength of the hives when they were put up in October. Having ascertained their relative weights, I calculate from them how long their stock of honey will last them, and their feeding is commenced accordingly. My whole stock is numbered 1, 2, 3, 4, &c. and on coming to town, I leave with my servant instructions in this way: for example, No. 1, to be fed at Christmas; No. 2, the middle of January; No. 3, the latter end of February; No. 4, need not be fed, as I consider it to be strong enough to get through the Winter without assistance.

A decided advocate, therefore, for feeding Bees during the Winter, and having ascertained the utility and advantage, as well as the mode of putting it in practice, I communicate my method, as I have successfully pursued it. The composition which I give to my Bees is moist sugar and sweet beer, boiled to the consistence of treacle; it is inserted into the hive in a small trough or scoop made of wood, hollow, and of this shape.



This is to be filled daily. To insert it into the hive

through the front door, would be to bring the Bees of all the adjoining hives to share it, and to engage them in fight and destruction: my bee-house, opening wholly at the back, I cut a hole large enough to admit the trough at the back part of the hive; and when the trough is inverted I shut the outside doors quickly: thus no Bees of the adjoining hives are roused; and the hive fed, enjoys the whole of what is given to it: the only attention required on the occasion is, to take care that the board or stool of the hive is perfectly level, least the food should be spilt, which would take place, if the board was higher either in the front or back part of the hive.

It is a received opinion among the common people, that no hive should be suffered to stand longer than three years, for it will certainly die in the fourth, or be good for nothing. No opinion can be more erroneous: I last year took a hive which had stood fourteen years, which I kept for the sake of the experiment, and which gave me a swarm the last season; but having cast a swarm last year, I found the number of Bees so reduced, and the hive so light, that it was impossible it could get through the Winter, and I therefore unwillingly took it.

I shall now conclude what I have the honour to offer to the Society with this observation, that the reward which the Society offers, either pecuniary or honorary, should be held out to him who produces the hive of given dimensions, of the greatest weight, and of course containing the greatest quantity of honey and wax. To give to him whose pretensions are the number and not the weight of the hives, is to enable any one to practise a fraud on the Society, whose object is, to hold out encouragement to the production of the greatest quantity of wax and honey, by inducing him to hive as a distinct stock, every late small swarm or cast, not one of which I have ever found yield the smallest quantity of honey fit for any purpose whatever.

I declare to the Society, that I was possessed of fifty-six stocks of Bees, previous to my beginning to take them in August last, 1817, all of which were composed of my old stock of the preceding year, and of swarms from them in the year 1817. My stock of the year 1816 consisted of 52 hives, 24 of which I carried through the winter without the loss of one, having taken the rest. From the 24 hives I had upward of 40 swarms and casts, which were hived in 32 hives.

ISAAC ESPINASSE.

# PAPERS

IN

# *CHEMISTRY.*

## DRY ROT IN SHIP TIMBER.

*The* GOLD MEDAL *of the Society was this Session presented to* AMBROSE BOWDEN, *esq., Navy Office, for a method of preventing and curing the* DRY ROT IN SHIP TIMBER. *The following communications were received from him on the subject.*

Navy Office.
April 9, 1818.

SIR;

IN June, 1815, I published a treatise on Dry Rot, a copy of which I presented to the Society for the Encouragement of Arts, &c. I am now happy to inform the Society that several of the measures I then recommended have been since adopted by government, particularly that of sinking ships in sea water, which has been attended with success equal to my most sanguine expectations.

A ship of 451 tons (the Eden) was sunk in November, 1816, and raised in March 1817, and on her being taken into Dock and opened last month, there was not the least

appearance of recent fungus, although many of her timbers had been destroyed by this vegetation, previously to her being sunk; and what old fungus was found on the timbers had been completely deprived of vegetable life. It is with infinite satisfaction I reflect on having discovered a simple, easy, cheap, and effectual remedy for a decay which has consumed the navy for many years past, at an expense of many millions sterling to the public. I now beg to appeal to the liberality of the Society for that consideration which so important a discovery deserves. I shall be happy to wait on the Society with documents sufficiently attested to prove the truth of these representations.

I am, Sir,

*A. Aikin, Esq.* &c. &c. &c.

*Secretary, &c. &c.* A. BOWDEN.

Navy Office,

SIR; April 12, 1818.

I OMITTED to state in my letter, as a confirmation of the efficacy of sinking ships to cure the Dry Rot, that many pieces of timber, which had lain for some years in the yard at Milford, had been much decayed by the growth of the fungus; but after they were immerged in the sea, the vegetation was entirely destroyed, and those timbers which were not too rotten, are now used for building ships without the least apprehension. In consequence of these satisfactory experiments, an order has been issued by the Lords Commissioners of the Admiralty, directing *all the timbers* and planks to be submerged after they are cut to the proper shape, and previously to their being used for building a ship. They have also ordered the Mersey (a ship built at the same time as the Eden, of the same tonnage, and nearly in the same state of decay) to be repaired immediately, and sunk when she is completed, in order that the

*new timber* used in repairing her may have the benefit of submersion as well as the old. I beg also to state to the Society that I have learnt, since the publication of my treatise, that accident has furnished us with two other instances of the good effects of sinking ships, in the San Fiorenzo frigate which was sunk off the French coast about 18 years ago, and the Resistance frigate, which was also sunk in attempting to heave her down in the Mediterranean about 8 or 10 years since: the latter ship is now under repair at Plymouth, and is perfectly free of fungus, which excited considerable surprise and inquiry; and the former is in the same favourable state. The fact, therefore, appears to be established, as completely as any fact can be proved, the Eden having been raised one year, the Resistance about ten years, and the San Fiorenzo about 18 years. Nothing more strongly shows the opinion entertained by the Lords of the Admiralty than the orders they have issued, and the consideration that they never would have given such orders (so contrary to former prejudices) on any other than an unquestionable foundation.

I am, Sir,

*A. Aikin, Esq.* &c. &c. &c.

*Secretary, &c. &c.* A. Bowden.

Besides the foregoing letters, copies were communicated to the Society of the following official papers confirming the statements in Mr. Bowden's letter, viz:

1. A recommendation from Mr. Commissioner Seppings, that the Eden and Mersey sloops of war, both infested with fungus, being new ships, built at the same place, and launched in the same year, should be selected for a comparative experiment to ascertain the effect of submersion in sea water. The Eden to be submerged, the Mersey not to be submerged.

2. Warrant to the officers of Plymouth yard to sink the Eden, November 16, 1816.

3. Survey of the Eden before submersion, November 16, 1816.

4. Report on the state of the Eden and of the Mersey, after the former ship had been submerged, September 8, 1817.

5. Report on the state of the Eden, March 7, 1817.

6. Letter from the Navy Board to the Admiralty on the state of the Eden, March 11, 1818.

7. Order from the Admiralty (7th April, 1818), to repair the Mersey, and afterwards to sink her, that the new timber may have the benefit of the immersion in sea water.

# PAPERS

IN

# *MANUFACTURES.*

## STRETCH FOR WOOLLEN WEAVERS.

TEN GUINEAS *were this Session presented to the Widow of the late* S. BRIERLY, *for his* STRETCH FOR WOOLLEN WEAVERS, *a model of which is preserved in the Society's Repository, and the following communications were received on the subject.*

Rochdale,
November 11, 1816.

SIR;

HAVING seen your name attached to the Society for the Encouragement of Arts, Manufactures, and Commerce, as secretary to the Institution, and conceiving that you are the proper channel through which any communication ought to be made, or any question to be asked, I beg leave to trouble you with a line of inquiry on a subject upon which I feel particularly interested.

A poor widow woman in this neighbourhood, who is in very humble circumstances, called upon me a short time ago, and inquired whether there did not exist in London a society which embraced the objects set forth in the designation of that Society to which you are attached: her

reason for making this inquiry was this: that her late husband, though merely a common weaver, or mechanic, had invented a machine much in use amongst the Woollen Weavers of this district. Previous to this invention, the Woollen Manufacturer, after sizing the warp, was obliged to extend it on some ill-contrived stretch in the open air to dry, and generally on the road side, or in some very inconvenient place, and unless a person were appointed to watch and guard it, boisterous winds, and the grazing cattle made them too often repent their negligence; and not unfrequently the warp was much injured or destroyed. The inconvenience of such an operation was severely felt, particularly in the Winter season, when families thus employed, were obliged to stop their work until the return of a dry day. The invention consists of a frame constructed in such a manner with moveable rollers, that the warp may be stretched and prepared for the loom in one-tenth of the time which the former operation required, and may be safely dried by the weaver's fire-side.

Without being myself much of a judge of matters of this sort, I can undertake to assert, from my own knowledge, that this invention does contribute very essentially to the comfort of the Weaver, as well as to the celerity and dispatch of his employment. Since the above application, I have made it my business to inquire into the truth of these premises, and can undertake to say, that, on all hands, the utility of this invention is acknowledged, and that I have met with many persons engaged in the trade, who ascribe the invention to Samuel Brierly, the deceased husband of this poor woman, and who would sign a deposition to that effect.

I have been induced to make these inquiries that I might not trespass on your valuable time, on uncertain grounds. The circumstances of this poor woman are such, that if your Society is of opinion with me, that

whatever promotes the simple operations of any manufacture tends to the welfare of the manufacture itself, and that this invention by so doing, is of sufficient importance to merit their attention, any reward or gratuity which they might think proper to give to her as the representative of the inventor, would be well bestowed; and might operate as a useful incentive to exertions which might in a similar manner promote the welfare of so important a branch of our commercial enterprizes.

I am, Sir,

*C. Taylor, M. D.* &c. &c. &c.

*Secretary, &c.* JOSHUA THOMAS HORTON.

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Rochdale,

SIR; May 29, 1817.

I HAVE to thank you for your obliging attention to my former letter, and to the request which it contained. In compliance with the desire of the Committee of Manufactures, I have procured two drawings of the machine. They are not very good, as we have no good professional drawer (if I may so express myself) in this place. They may perhaps suffice to give an idea of the instrument; if not, I will endeavour to procure a better description elsewhere.

I enclose a certificate of those points on which the Committee insisted. I have procured the signatures of twenty-two of the oldest weavers in the county, and thought it unnecessary to obtain more; but I beg leave to add, that if it could be of any use, I might obtain signatures to almost any extent. Of my own knowledge I can assert, that the invention has been of inestimable service to the trade, and a general convenience to the whole country. The dimensions of the Stretch are such

as to admit of its being used in-doors if the weather is bad. Before this invention took place, the public roads, and the fields were completely infested with persons drying their warps, to the serious inconvenience of travellers, and to the great injury of farmers. It is a fact generally admitted, that the increase of building in this town, the inhabitants of which are principally weavers, is mainly attributable to this invention, inasmuch as prior to its taking place, the occupation of weaving was quite incompatible with residence in a town.

In conclusion I can only again commend this case to the attention of your committee; begging leave to add of my own knowledge, that any reward which they may think proper to award to the widow of Samuel Brierly the inventor, will be of inestimable service to her, and I humbly conceive of some considerable benefit to society, as an incentive to future discoveries and improvements. The second Stretch which was made, is still in existence, and is kept as a curiosity by Abraham Healey, whose name appears first on the enclosed list.

I am, Sir,

*A. Aikin, Esq.* &c. &c. &c.

*Secretary, &c.* JOSHUA THOMAS HORTON.

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## CERTIFICATE.

Rochdale,
April 28, 1817.

WE, the undersigned, woollen weavers in the Parish of Rochdale, hereby declare and certify, that the late Samuel Brierly was the sole inventor of the drying frame called a Stretch, about the year one thousand seven hundred and ninety seven; that the machine is in actual, general, and almost universal use, and is approved by the

woollen weavers in the vicinity: that the cost of the machine is about two pounds, and that from the period of its invention to the present day, it has been daily advancing to general adoption, with very material benefit to the trade, and to the great advantage and comfort of weavers; who, prior to this invention were exposed to every vicissitude of weather, and were dependent on the good nature of those farmers who would allow them an entrance into their fields: we further declare and certify that material injury resulted to the warp from the want of such an invention, both by the depredations of cattle, and by other inconveniences attached to its exposure in public situations.

*(Signed)* Abraham Healey,
William Whitehead,
John Whitehead,
John Fitton,
Joseph Hill,
Nathan Holt,
John Butterworth,
George Ashworth.
Robert Ashworth.
George Harley,
Richard Hartley,
Joseph Laycock,
James Brierley,
James Wrenshaw,
William Schofield,
Samuel Healey,
John Crabtree,
James Wild,
Robert Chadwick,
Robert Collinge,
James Howorth.

*Reference to the Engraving of Mr.* SAMUEL BRIERLY'S *Stretch.*

Plate IV, fig. 5, a side view, showing the Warp stretched on the rollers in a zigzag direction, from bottom to top; *i i i i*, four handles to carry it by.

Fig. 6, an end view showing the rollers: they go into holes in the right post as *k k k k*, fig. 7, and drop into grooves in the left post as *l l l l*, figs. 6 and 8.

Scale one inch to a yard.

# PAPERS

IN

# *MECHANICS.*

## N° I.

## LIFE-PRESERVER.

*The* GOLD MEDAL *of the Society was this Session voted to* THOMAS GRANT, *Esq. of Bideford, now of Plymouth, for a* LIFE-PRESERVER *in cases of Shipwreck. The following communications were received from him on the subject, and a Model of the Invention is preserved in the Society's Repository.*

Bideford,
Nov. 27, 1817.

SIR;

OWING to the many fatal cases of Shipwreck that happen every year upon this coast, and circumstances having frequently made it impossible to afford relief to the vessel in distress by means of the best constructed life-boat or captain Manby's mortar; and although a variety of Life-Preservers have been invented for ships, yet probably from their being too complicated or requiring much care and attention none of them have yet been brought into general use.

The loss of sixteen men in the Ellen a few months since (a melancholy event that has left widows and fatherless children in a most deplorable situation) is precisely such a case as above described, and had there been a life boat upon the coast abreast of where she foundered, it would have been impossible for it to have reached her in time to save the crew from perishing—and she was lost at too great a distance from the shore to have effected a communication by means of captain Manby's apparatus; and even had there been a boat on board, she could not have lived in so tremendous a sea: these circumstances have induced me to offer a few observations upon what appears to me the most simple method of saving such valuable lives in future.

I have for some months given up what time I could spare from my official duties to this point, and after a variety of contrivances with different articles, I at length determined upon the conversion of a ship's water cask into a Life-Preserver, which has now undergone many trials, and been found adequate to its important design; it is simple, the expense trifling, and requires no care. All the ships water casks now in use could be converted into Life-Preservers upon this plan in a few hours. The bed and bung once completed, and fourteen iron thimbles and five dozen bottle corks procured, all the rest is sailors work, as the cask is attached to the bed by lashing only, without a single nail in any part of it.

Independant of the bed and all the other apparatus, I allow about one pound and three quarters of cast iron to every gallon of air for ballast, and three gallons of air for each man: for instance, a 36 gallon barrel requires 8 feet of $1\frac{1}{2}$ inch plank, 6 fathoms of 2 inch rope, 15 fathoms of inch line, 5 dozen corks and 63 lb. of cast iron for ballast, and will support twelve men in sea water: it is always at hand, occupies no more than the usual

space, and no part of its apparatus is in the way; for which reasons I presume it will be considered preferable for merchant vessels to any thing else of the sort hitherto invented, however ingenious in construction; for all that is essentially necessary for its preservation is, to keep it water tight, which is done by the use that is made of it for daily purposes, and when a case of danger occurs it is only to cut the deck lashing and discharge the water, to secure the bung, and throw the cask overboard; and the land being to leeward, the wind and sea will set the cask and men towards the shore. Men who from fatigue or cold are unable to hold on, have a seat, and are supported round the back, consequently are carried in perfect safety without any exertion; and from the manner in which the ballast is fixed, the cask will always float steadily, and cannot roll or upset.

No less than twenty-four vessels have been wrecked within the limits of two ports upon the coast in one year, and upon a moderate calculation thirty wrecks at least happen every year between the North side of Bideford bay and the Land's-end: many of which melancholy events, from my official situation, I have been an eye-witness to, and most of them have happened under the circumstances mentioned in the beginning of my letter.

Communication might be effected with the shore by taking one end of a line from the ship.

As the bung hole is made large enough to admit a man's arm, the cask is the sooner emptied, and any valuable property or ship's papers can be put into it. A coaster having but few hands, might save the greater part of their clothes.

It would be advisable upon the first approach of distress to get the cask ready by discharging the water, and after putting into the Life-Preserver whatever might be

thought most essential to save, secure the bung, and when extreme danger obliges the crew to quit the ship, there is nothing more to be done but to cut the deck lashing, and throw the cask overboard.

The cask, the bed, and the rope work, separate from each other in case of any repairs being wanted to either, and to guard against accidents, there is a duplicate of every thing, so that if one or two lashings give way, the rest will support the whole.

I thought it advisable with the view of bringing it into immediate use, to request the mayor and corporation would recommend it to the notice of the merchants and ship owners of this town, when fully satisfied of its utility, and to use their influence to induce them to adopt it in every ship: the reply I received from the corporation and from Sir Richard Keats, I now beg leave to inclose for the purpose of being submitted to the Society for the Encouragement of Arts, &c.

It has already been so well received at this port in consequence of the humane exertions of the corporation to get it into general use, that several of the ship owners have ordered the water casks in their vessels to be made into Life-Preservers, from the one I first constructed.

Various improvements will no doubt be made on this simple invention by mariners of ability, whose observations and experience enable them to form the best judgment of all nautical contrivances.

I feel diffident of my own skill in maritime affairs: I have been actuated in these suggestions only by a wish to prevent the dreadful havoc of lives which yearly occurs upon this iron-bound coast. I beg to add that you will shortly receive a model of the invention, accompanied by drawings, &c. and I shall be most happy if it proves beneficial in saving the lives of shipwrecked seamen under the

peculiar circumstances before described, and trusting that my humble endeavours to assist in the cause of humanity may be approved by the Society of Arts, &c.

I am, Sir,

*A. Aikin, Esq.* &c. &c. &c.

*Secretary, &c. &c.* THOMAS GRANT.

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Town-hall, Bideford,

SIR; Oct. 31, 1817.

WE have witnessed the experiment this day tried with your newly invented Life-Preserver, being a water cask of 36 gallons, whereby ten men were at the same time kept floating with their heads considerably above the water in a strong current at ebb tide, through Bideford Bridge. The invention appears to us admirably calculated for general benefit, and we consider it well deserving the attention of nautical men, particularly mariners employed in the coasting trade, and the cheapness at which it is procured, the simplicity of its construction and its applicability to the purposes of a water cask on board ship, are in themselves strong recommendations for its adoption.

We are, Sir,

&c. &c. &c.

WILLIAM TENDREW, *Mayor,*
R. G. KEATS, *Recorder,*
CHARLES CARTER, *Justice,*
THOMAS BURNARD, *Alderman,*
THOMAS BURNARD, *jun. Alderman,*
LEWIS WILLIAM BUCK, *Alderman,*
LAWRENCE PRIDHAM, *Capital Burgess,*
THOMAS VILLARETT, *Capital Burgess,*
JOHN HOGG, *Capital Burgess,*
JOHN HANDFORD, *jun. Capital Burgess,*
WILLIAM CALLON, *jun. Capital Burgess.*

*Thomas Grant, Esq. Bideford.*

Bideford,
December 5, 1817.

This is to certify, that we have seen a ship's water cask converted into a Life-Preserver, according to the invention of Mr. Grant, Collector of his Majesty's Customs at this Port, and have no hesitation in saying, that we consider it the best contrived Life-Preserver for merchant vessels we have ever seen, and strongly recommend its being adopted in every ship.

James Lillicrap *Capt. R. N.*
Gustavus Stupart, *Capt. R. N.*
Charles Clyne, *Capt. R. N.*
Richard Buck, *Capt. R. N.*

When the cask is used as a water cask, it is lashed to the deck in the usual way, for which purpose there is a lashing at each end of the bed the cask stands upon; the longest cork loops *b*; fig. 1, plate 2, are drawn tight round to each end of the cask; the cork lines *q*, coiled up, and the end foot ropes *a*, are all stopt together by a single twine stop, fixed to the end lashing, and stowed between the head of the cask and the lashing, and the side ropes *a*, are put upon the bed, so as to be out of the way.

When a case of danger occurs, the first thing to be done is, to cut the deck lashings, then empty the cask, secure the bung, cut the twine stop, spread the cork lines *q*, at each end, and throw the cask overboard, or lower it down the side by a rope rove through one of the end foot ropes *a*, by which the Life-Preserver can be kept floating near the ship's side till the men are all ready, when they have only to let go the end of the rope, and quit the ship.

The corks make the lines float, and prevent the hands from slipping. The men have thereby a better hold; it also prevents galling when the loops *b* are applied round the back.

§

The smaller cork loops *k*, afford a more convenient hold when the men get close to the cask. Fatigued men can sit or stand on the ropes *a*, and by putting the largest loop *b*, over the head, and getting it under one arm at a time, he will have the bight round his back, as shown in those floating to shore, fig. 5. He is thus secured in an easy seat, and carried in perfect safety without any further exertion.

The bed the cask stands upon is nearly square. The cask might be double-headed, and should be painted of a light colour, that it might be the more readily seen at night.

In approaching the shore, the men should disengage themselves from the foot-ropes *a*, and the loops *b*, before they strike the ground.

### *The Ballast.*

With regard to the ballast, they cast iron to any pattern at the founderies, and all the directions necessary to be given are, that the piece is not to be more than two inches thick, to be nearly square, and to weigh pounds.

The weight of cast iron ballast for common sized water casks is as follows:

A kilderkin (18 gallons) requires a cast iron slab of two inches thick, weighing 32 lb. and will support six men in sea water.

A barrel (36 Gallons) requires a piece of the same thickness, weighing 63 lb. and will support twelve men.

A hogshead (54 Gallons) requires a piece of the same thickness, 95 lb. and will support eighteen men.

### *The Bung.*

The bung should be made in shape of an oblong square, and large enough to admit a man's arm. Saw it out of

a piece of inch thick cork, with a common sash saw, and fit it nicely with a wood file. Cover the top of the bung with a piece of sheet iron, about $\frac{1}{8}$ of an inch in thickness: the hinge and hasp are cut out of the same, and the iron plate rivetted through the thickest part of the cork by five small rivets, the centre one having an eye upon the top, to which the fore-lock that secures the bung is fastened, as shown in the model.

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*Reference to the Drawing of Mr.* GRANT'S *Life-Preserver, in cases of Shipwreck,* Plate II.

Fig. 1, perspective view of the Life-Preserver.

Fig. 2, the upper side of the bed, *e* the eye bolts which receive the lashing; *f g*, the ring bolts to which the foot ropes *a*, are spliced, and which also serve to lift the whole apparatus up by; *h*, eyes rivetted upon iron clamps, which receive the end lashings of the cask, and also the deck-lashing; *m*, three pieces of wood fixed upon the bed, and cut so that the cask bears equally upon all, and the ends of the cask being let into the end pieces, it is prevented from shifting either endways or sideways; *n*, side pieces, which prevent a heavy stroke of the sea from getting between the cask and the bed, so as to act as a wedge that might occasion a great strain on the lashings, and endanger the cask's being separated from the ballast.

Fig. 3, the under part of the bed; *o*, the ballast, which is not to be more than two inches thick, and to be fixed as near the centre as possible; *p*, two wooden ledges about four inches broad, and sufficiently thick to keep the ballast clear of the deck.

Fig. 4, side view of the bed.

Fig. 5, view of the Life-Preserver supporting six men, and drifting from the vessel to the shore.

# Mr. T. Grant's Life Preserver. Pl. 2.

Fig. 5.

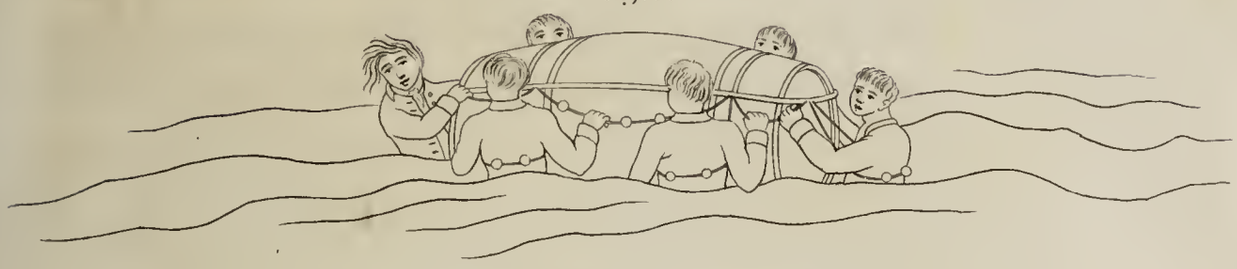


Fig. 2.

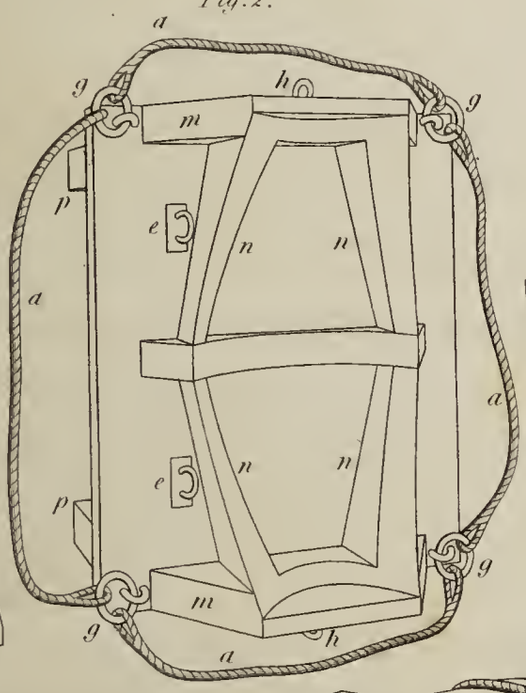



Fig. 4.

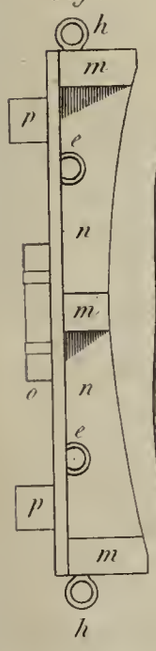



Fig. 6.

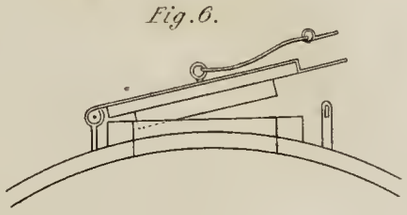


Fig. 3.

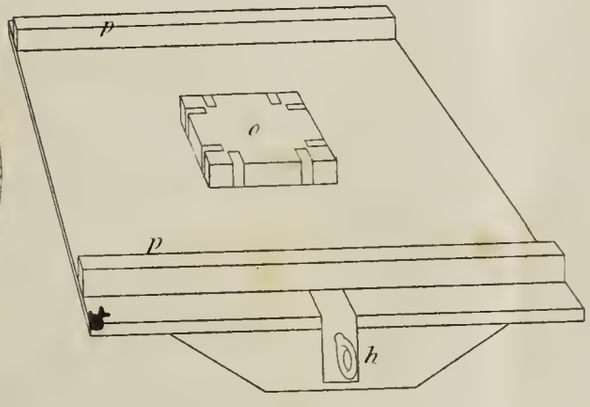
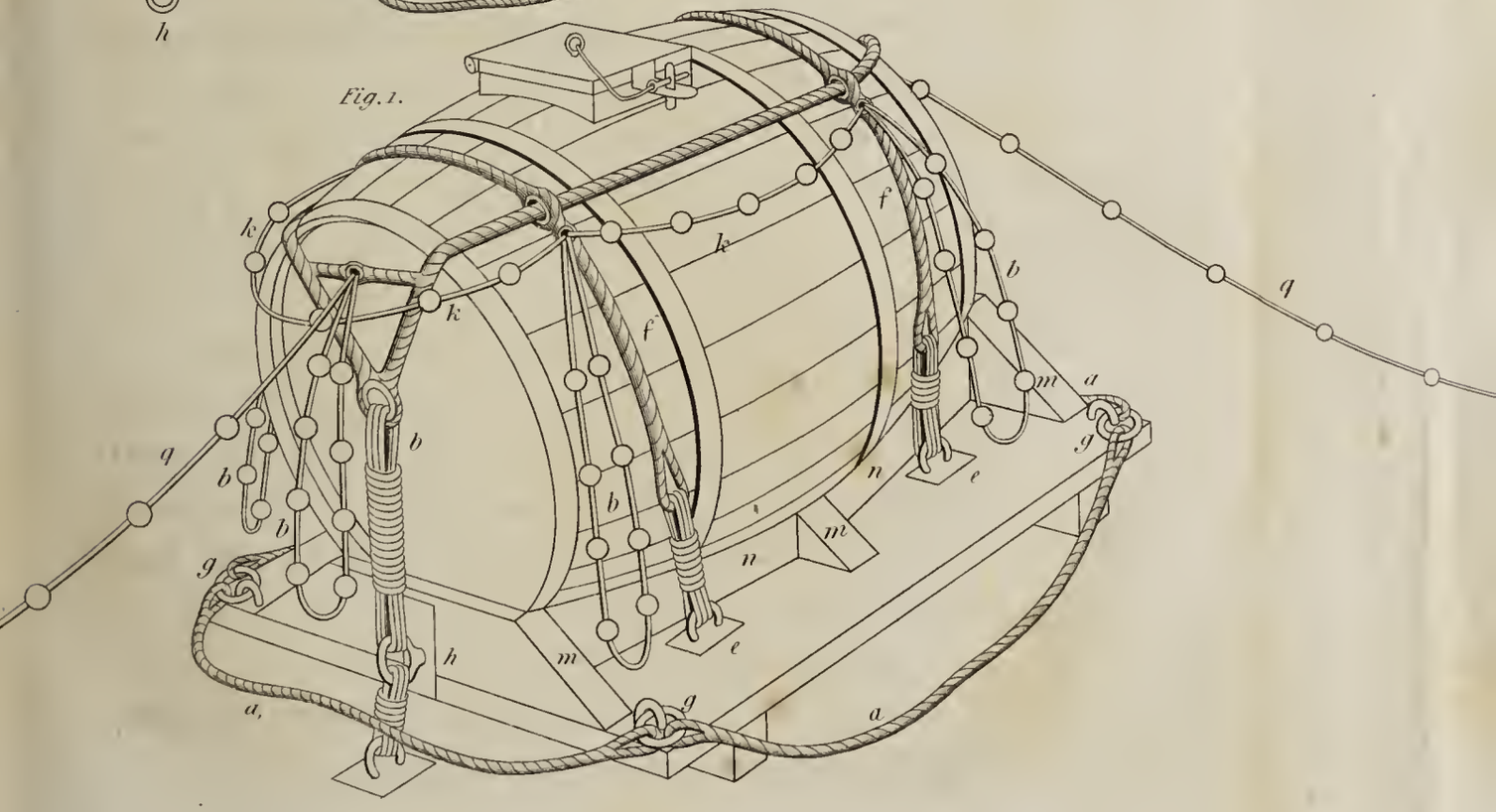



Fig. 1.




Drawn by C Varley

Engraved by J.B. Taylor

Fig. 6, section of the bung and bung-hole, the joint being separated.

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## N° II.

## DOOR-SPRING.

*The* SILVER ISIS MEDAL *and* FIVE GUINEAS, *were this Session voted to Mr.* J. HENLON, *of Welbeck Street, for a* DOOR-SPRING. *The following communication was received from him on the subject, and a Model of the Invention is preserved in the Society's Repository.*

69, Welbeck Street,
April 28, 1818.

SIR;

You will oblige me by laying before the Society for the Encouragement of Arts, Manufactures, and Commerce a model of an improvement which I have made in a Single Door Spring, manufactured by my employers, Messrs. E. and J. Dowson, of Welbeck-street. My object has been to give an increased power to the spring when the door is shut, and thereby an additional resistance to the current of wind in passages, &c. where spring-doors are particularly useful. In a door of the common construction, the springs act with increased power in proportion as it opens, but in that which is the subject of the present communication, I have diminished the resistance, and thus, I trust, have accomplished my object, to make a door to act as pleasantly as possible, where such a contrivance is found

necessary to keep it shut. Should the model sent be thought worthy of the notice of the Society, I shall be happy to attend, and give any explanation in my power.

I am, Sir,

*A. Aikin, Esq.* &c. &c. &c.

*Secretary, &c. &c.* JOHN HENLON.

---

*Reference to Mr.* J. HENLON'S *Door-Spring*, Plate III.

Fig. 1, represents part of the door frame in section with the whole of the Door-Spring in its place in the top of the door, the door, however, being removed to show it.

*a*, the upper frame; *b*, the post to which the door is hinged; *c c*, the plate of the spring which is fastened on the door by the screws *d d*; *e*, a screw which holds the cock *f*, in which the wire *g h*, is secured, but so as to turn round at the end *h*, which is nicked for a screw driver; round this wire is wrapped the steel wire spring (shown fig. 2.); *i*, an iron bar with a ring *k* (fig. 2) fixed to it, through which the wire *g h*, passes: the spring presses against this ring, and keeps the bar at that end: the other end of the spring acts against a nut *l*, which is screwed on the wire: *m*, a perforated plate, screwed to the door frame, above which the wood is cut away to make room for the roller *n*; this roller is connected by the moveable arm *o o*, to the bar *i*, against the end of which the Spring acting keeps the door shut. Fig. 3, a bird's eye view of the door shut, the upper frame (to which the plate *m*, is screwed by the holes *p p*,) being removed; the leverage by which the door is held, is nearly as long as its thickness, and this length decreases as much as the moveable arm *o o*, and roller *n*, approach the door hinge *q*.

Fig. 4, shows the door opened at right angles to the

# Mr. I. Henlon's, Door Spring.

Pl. 3.

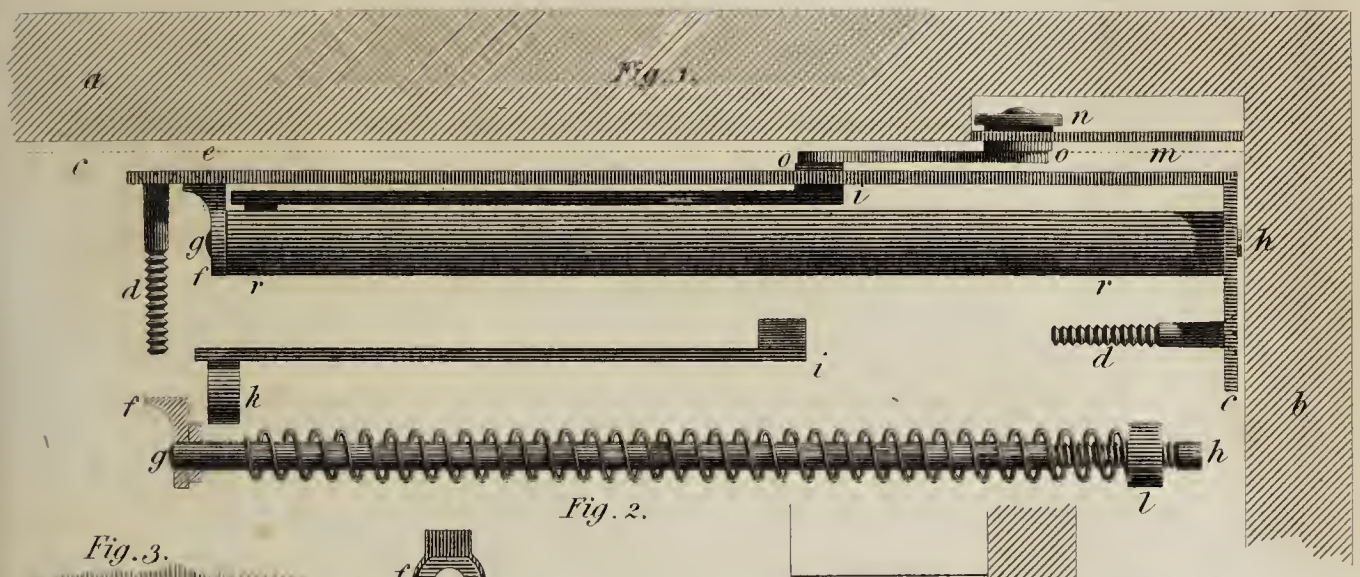


Fig. 2.

Fig. 3.

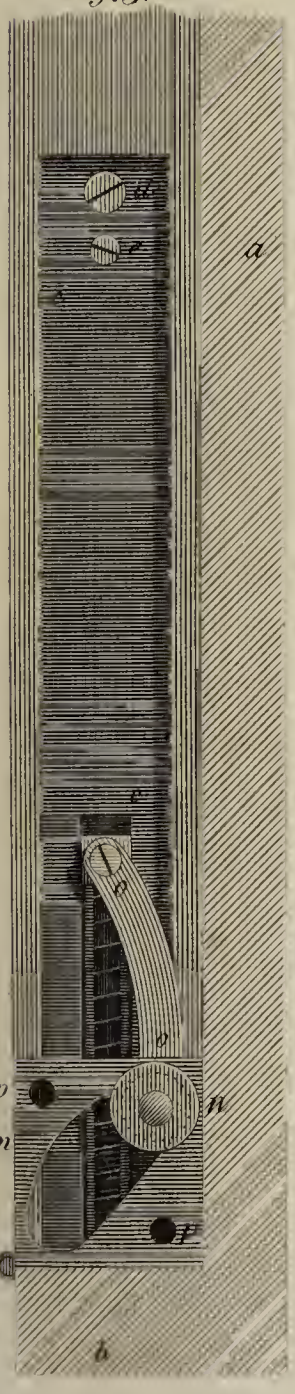

Fig. 6.

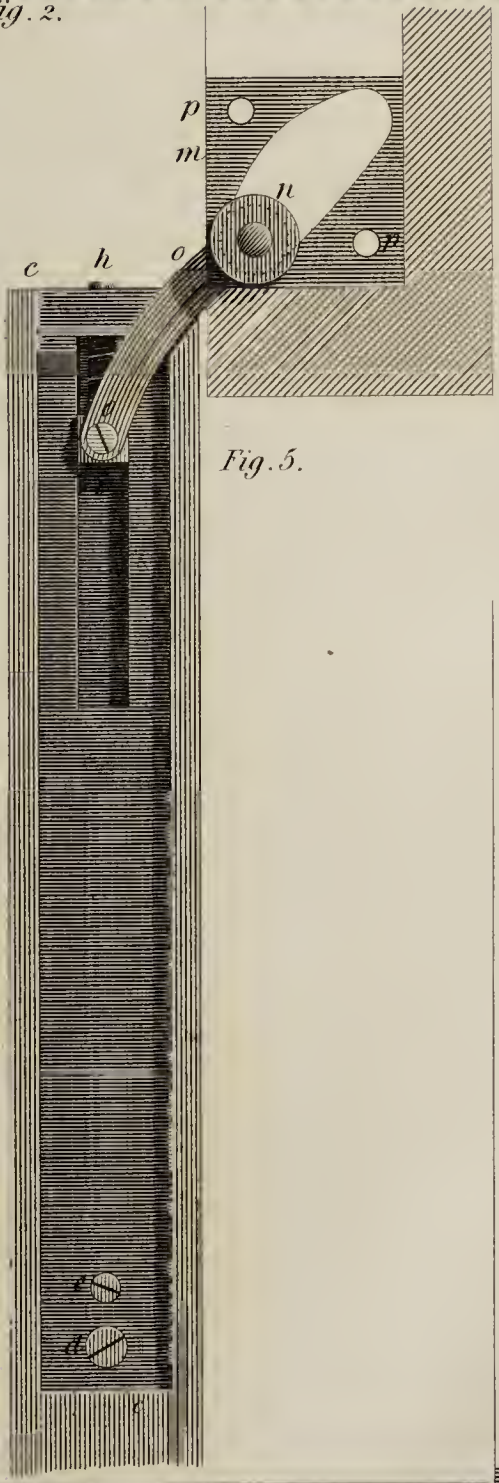


Fig. 5.

Fig. 7.

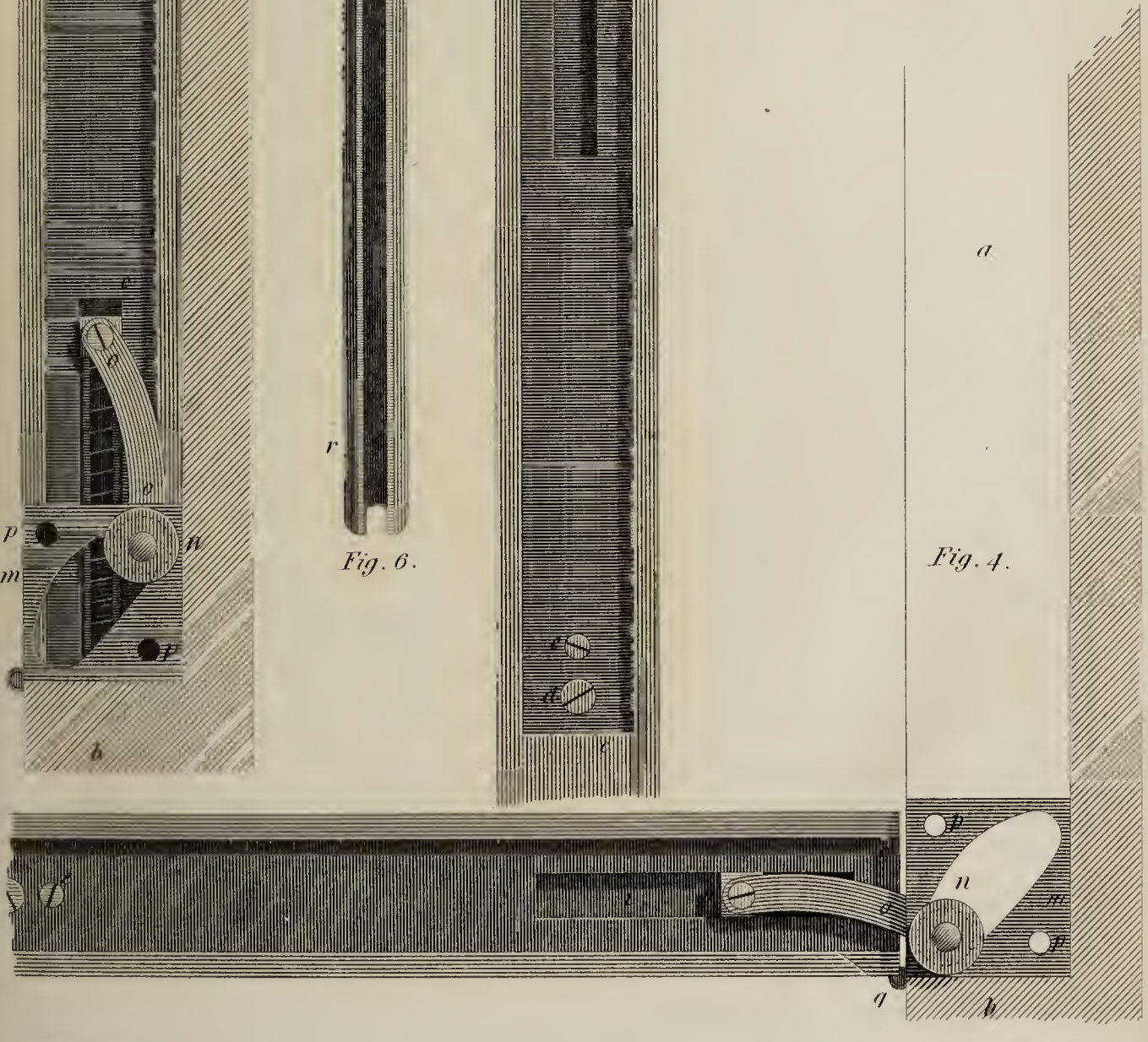


Fig. 4.

Drawn by C. Varley.

Engraved by J. B. Taylor.

frame, by which the roller *n*, has travelled from one end of the perforation to the other next the hinge, and reduced the lever to one quarter of its length from the hinge, and consequently lessened in the same proportion its power to shut the door.

Fig. 5, shows the door opened quite back, now the moveable arm *o o*, lies over the hinge, and therefore the spring, though increased in action, has no power to move the door; but if made to pass the hinge a little farther, will hold it open. Fig. 6, *r r*, an iron pipe, open on the upper side; this goes over the spiral spring, and one end fits on the neck of the cock *f;* the notch and pin at *s*, keep it from turning round; the open side makes way for the end *k*, of the bar *i k*, to travel, the other end fits on the screw nut *l;* this nut has a neck which, rising through the open side of the pipe *r r*, is prevented from turning round (shown separate fig. 7), and by turning the wire *g h*, with a turn-screw, the nut advances to increase the force of the spring if required.

## N° III.

## RULER AND QUILL-HOLDER.

*The* SILVER MEDAL *was this Session voted to Mr.* T. LANE, *of Stockwell, for a* RULER *and* QUILL-HOLDER. *The following communications were received from him on the subject, and a Model of the Invention is preserved in the Society's Repository.*

Chapel Street, Stockwell, Surrey,
March 16, 1818.

SIR;

I REQUEST that you will have the goodness to lay before the Society of Arts, &c. two instruments of my invention, for the purpose of enabling a person who has lost one hand, to make or mend a pen, and to rule lines. The occasion of my inventing these instruments was the following: Some time ago I was applied to by a gentleman who, having had the misfortune to lose his left hand, had come to London in order to procure some mechanical substitute which might enable him to pursue his occupation as usher in a school. After taking the subject into consideration, I made models in wood of the instruments alluded to, which, in the opinion of the gentleman, gave such fair promise of success, that he authorized me to get them completed.

It will be seen from the subjoined letter, that in fact they have completely fulfilled the object in view, on which

account I am induced to lay them before the Society, in the hope of obtaining their approbation, and thereby of rendering the invention more extensively known.

I am, Sir,

&c. &c. &c.

THOMAS LANE.

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Gloucester,

SIR; October 21, 1813.

I RECEIVED the Pen-mending machine and Ruler which you contrived for me, and I am glad to inform you that I find them both of great service.

My continual engagement in the business of our school, has occasioned this long delay of due acknowledgments for your very ingenious invention, which so well supplies the unfortunate loss of my left hand.

I hope my letter will arrive in time for the purpose you mentioned, and you may be assured that I shall, on all occasions, rejoice in bearing testimony to your skill in contriving these useful instruments.

I am, Sir,

&c. &c. &c.

THOMAS HOLMES.

---

Gloucester,

SIR; October 21, 1813.

AT the desire of Mr. T. Holmes, Rev. Richard Raikes most readily attests the efficacy of his Pen-mending machine and Ruler.

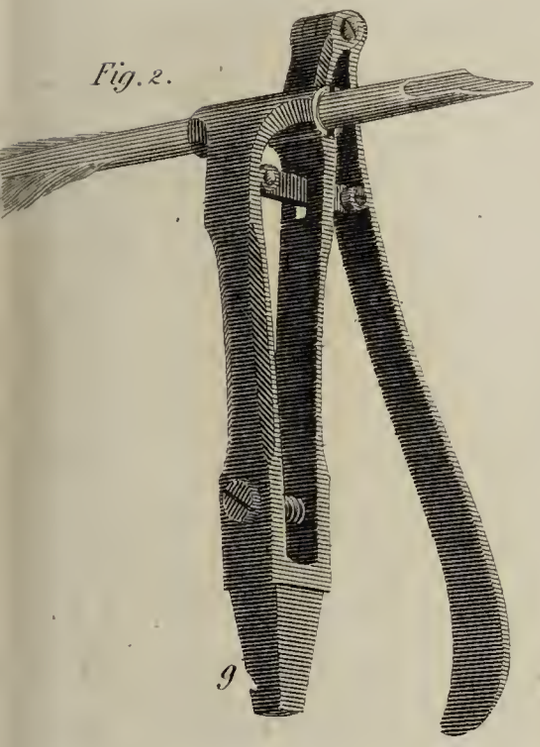
RICHARD RAIKES.

*Reference to the Figures,* Plate IV.

These instruments fit, by means of a notch *g*, in a socket, which is in a block at the wrist, as in the usual way. The instrument for mending pens is made of steel spring tempered. Fig. 1, *a a*, are the two springs; *b*, a screw to tighten the springs, so as to hold the pen as tight as required, not to slip in cutting; *c*, the lever, to bear down on the desk or table, which, by acting on the bar *h*, separates the jaws *d d*, to admit the pen; the lever *c*, being then raised off the desk, the jaws close on the pen. Fig. 2, a perspective view with a pen inclosed, *(scale half the real size)*. The ruler, fig. 3, fits in the same socket as before; its frame is made of steel, with a screw at *e*, to raise or lower it to a convenient height, to rest on the paper, which steadies the ruler while drawing the line. Fig. 4, an end view of the ruler, *g g* the square ends which fit in the socket, *(scale one third the real size)*.

# Mr. T. Lane's, Pen-holder & Ruler. Pl. 4

Fig. 2.



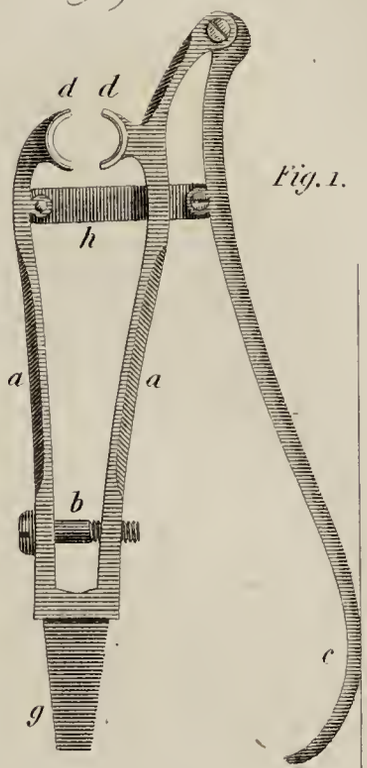




Fig. 1.

Fig. 4.

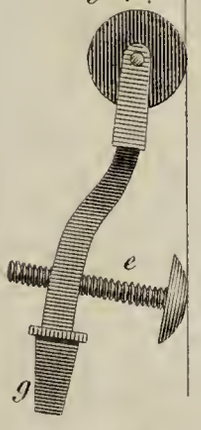



Fig. 3.

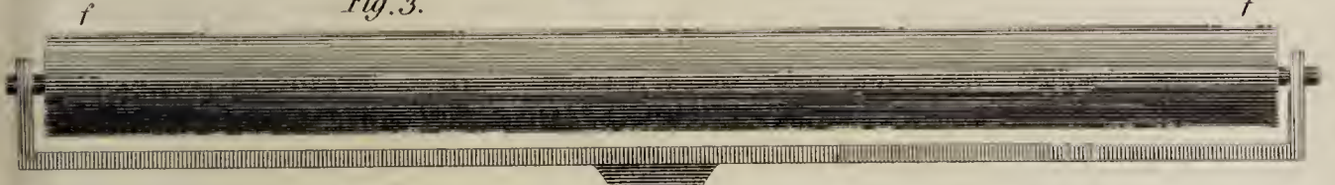
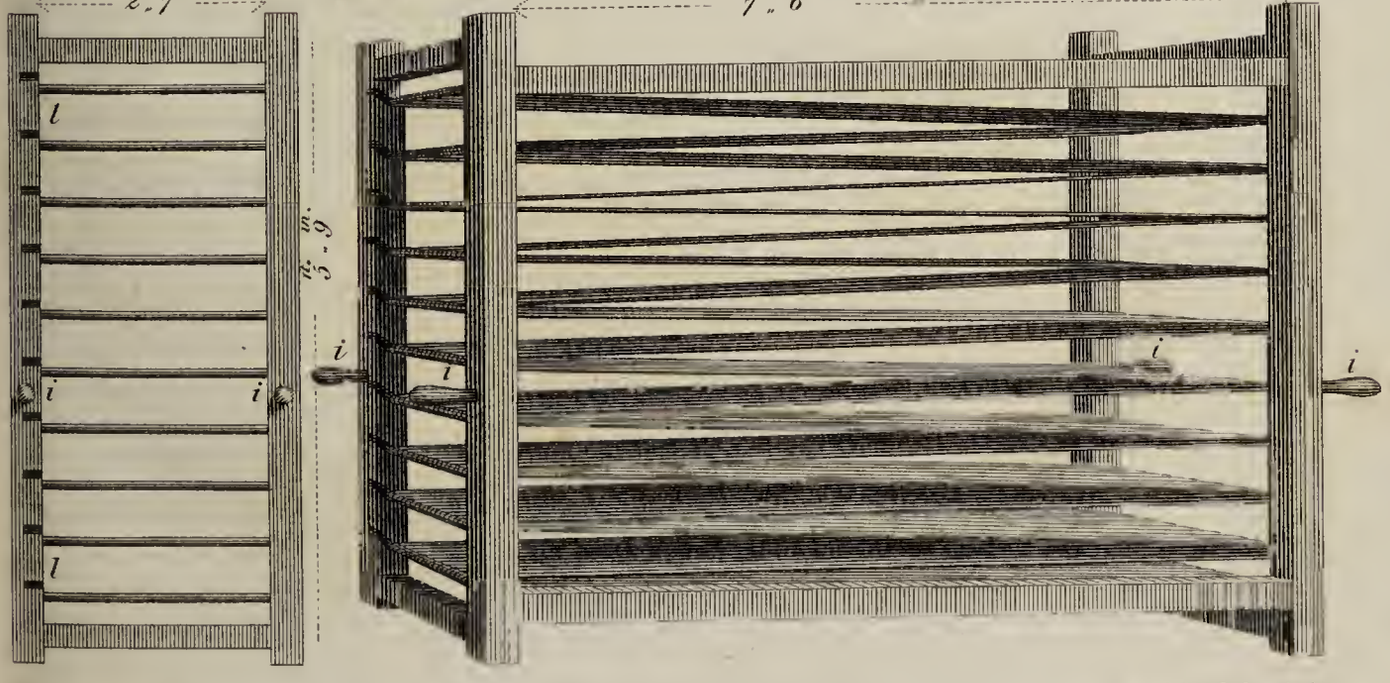


Fig. 8.

Fig. 7.

Fig. 6.

Fig. 5.




Drawn by C. Varley.

Engraved by C. Gladwin.

# Mr. S. Brierly's, Stretch for Woollen Weavers.

## N° IV.

## MACHINE TO PREVENT ACCIDENTS IN DESCENDING MINES.

*The* Silver Isis Medal *was this Session voted to Mr.* G. Prior, *of Howard's Green, City Road, for a* Machine to prevent Accidents in descending Mines. *The following communications were received from him on the subject, and a Model of the Machine is preserved in the Society's Repository.*

SIR; May 10, 1807.

In consequence of the late misfortunes which have happened in this part of the country, by the breaking of the ropes by which men and coals are let down and brought up at coal pits, I have been induced to visit them, and see if I could not discover some method or other by which such misfortunes could be prevented. I find the coal pits have an upright sliding frame, made of wood, cased with iron from top to bottom, supported in different parts by beams across the pit, on which a frame slides, made very strong of iron, to prevent the rope from untwisting when a weight is applied at the end of it. I have represented a coal pit in the model inclosed, with the sliding piece or frame which supports the corve or bucket as they are used; to which is added an invention by which I hope such accidents will in future be prevented, where it may be applied.

It is not at all necessary for me to give any explanation of the machine, on account of its simplicity of construction, as its advantages will appear by hanging on the weight to the frame which slides on the upright pieces which go down into the Pit, and hooking on the string at the top which will allow it to be raised or lowered without any obstruction. By slipping the ring from the hook at the top of the frame which supports the weight, the effect will be the same as if the rope had actually broken; and you will find the instant the rope is let loose, two powerful clicks, with centres of motion on the side of the moving frame are brought into action: the arms of these clicks go through holes cut in the sides of the frame, and meet each other in the middle in such a manner that a bolt may pass through them, and at the same time through a block which is astride the bar which holds the frame together: at the top of this block is a hook to which the rope is fastened. When in use, the rope bearing the sliding frame with the corve or bucket, pulls the heads of the clicks close up to the bar which is over them, and draws their ends from the sides of the sliding frame which goes down to the bottom of the pit, which is armed with strong iron pieces driven or screwed into them at small distances.

In case of accident by the rope giving way, the clicks instantly present themselves to the sides, by the elasticity of the springs which are under them, screwed fast to their frame, which may be made very strong, as there is no danger of their breaking, being required only to bend so little. Elasticity being much quicker in its action than gravity, the frame with the corve or bucket is sure to be stopped by the first bolt they meet with, and will remain suspended in the pit until another rope can be procured by which means the lives of the men in the bucket will be preserved. If by the concussion at any time the bolt which passes through the joint of the click should

break, the sides of the frame will instantly become the fulcrum, and will not in the least prevent the click from action, but will in fact press it tighter against the upright pieces to which the bolts are affixed. The clicks, when the rope is attached, have not any weight to support on their joints, as their heads through which the bolt passes in the block support or rest themselves against the beam which combines the sides of the frame together.

I am, Sir,

*A. Aikin, Esq.* &c. &c. &c.

*Secretary, &c. &c.* GEORGE PRIOR.

*Reference to the Engraving of Mr.* PRIOR'S *machine.*

*g g*, figs. 2 and 3, represent the iron frame to which the corve or basket is attached; *h h* is the upright slider fixed on the inside of the coal pit shaft, which fitting into a groove in the frame *g*, fig. 3, serves to direct the motion of the frame as it is raised or lowered.

*b*, figs. 1 and 2, is the hook by which the frame is suspended to the rope. This hook is shown more in detail, fig. 7, in which the upper eye receives the cross bar of the frame, and the lower eye with its bolt secures the extremities of the bars or clicks *c e*, fig. 1, which form part of Mr. Prior's invention. Each of these clicks is attached by its angle to a projecting piece of the frame *d*, figs. 1, 2, 5, which serves as the centre of motion to the click; *f f*, figs. 2, 5, are strong springs fixed to the outside of the iron frame, and bearing on the clicks with a constant tendency to throw them outward.

The action, therefore, of Mr. Prior's contrivance is obvious. While the frame remains attached to the rope, the arms *c c* of the clicks being raised somewhat above a horizontal position, overpower the springs, and press the other arms, *e*, of the clicks close to the sides of the frame, as shown in fig. 1. But when, in consequence of the

rope breaking, no counteraction is opposed to the springs, these, acting on the arms *e*, throw them out so as to cause them to catch on the nearest cog of the upright slider *h h* and thus prevent the descent of the frame, as represented in fig. 2.

Fig. 4, shows the two clicks bolted loosely together by their short arms, and perforated at their angles by a small hole through which the bolts pass, which are their respective centres of motion; and which bolts are secured in the piece *d*, figs. 2, 5.

Fig. 8, shows the frame with the corve, suspended in the middle of the shaft by the action of the clicks, the rope having broken.

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## N° V.

## PERCUSSION GUN LOCK.

*The* SILVER MEDAL *was this Session voted to Mr.* COLLINSON HALL, *of High Street, Mary-le-bonne, for a* PERCUSSION GUN LOCK. *The following account contains the substance of the communications received on the subject.*

THE cock, or hammer, and the touch-hole are the only parts in which Mr. Hall's gun differs from those in ordinary use; and these parts are so simple that a common lock may be converted into a percussion lock on Mr. Hall's plan, at a very small expense.

The detonating powder which is used for the priming is made into the form of a pellet, and is fixed in the centre of a small round piece of paper covered with wax. In

# W.ᵐ G. Price's, machine for preventing accidents in descending mines.

Pl 5.

Fig. 8.

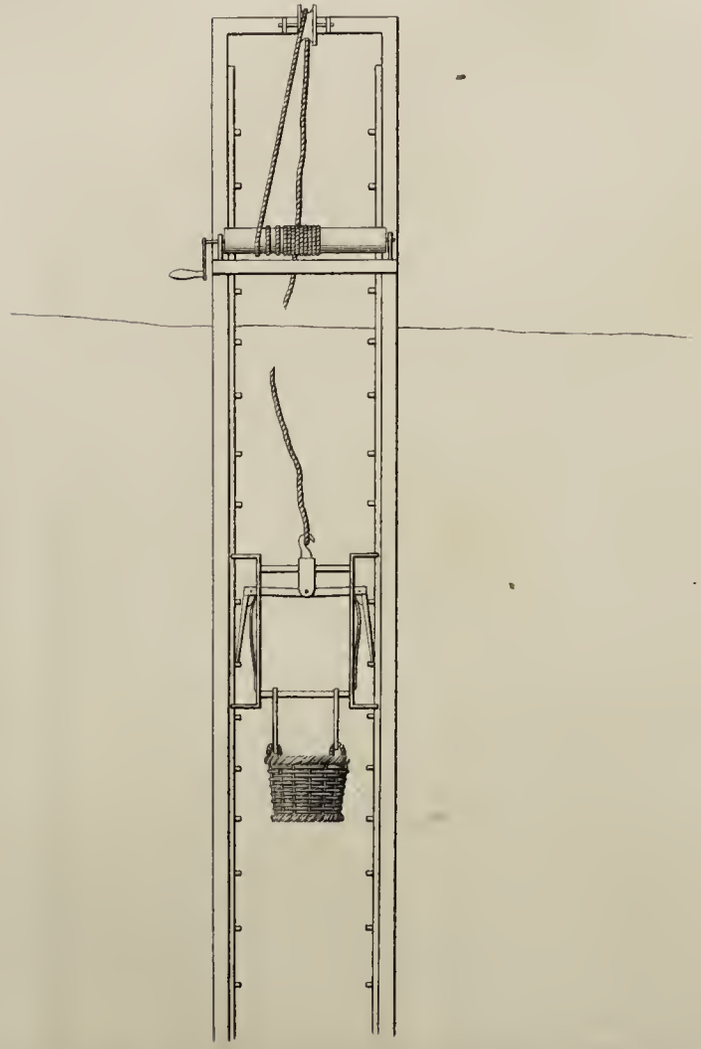


Fig 1.

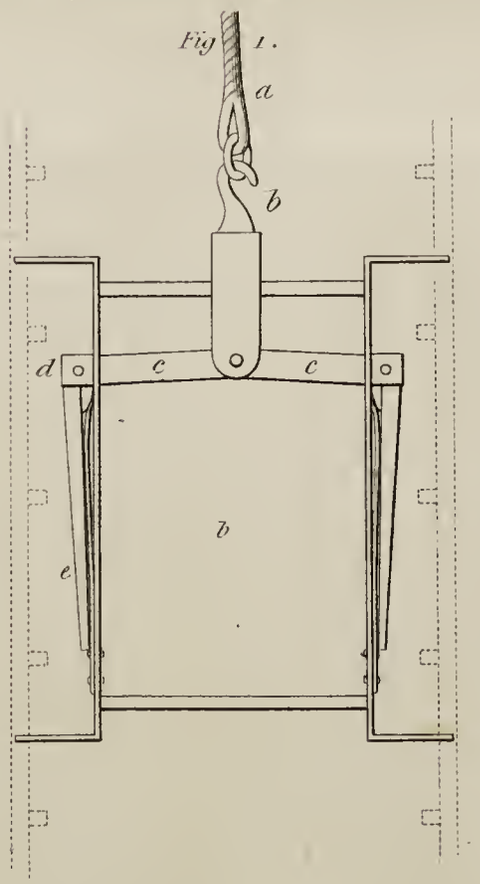
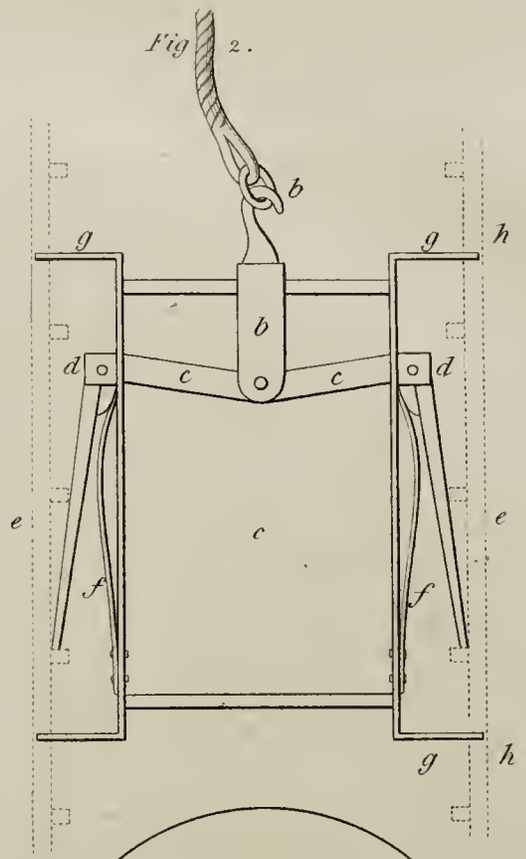
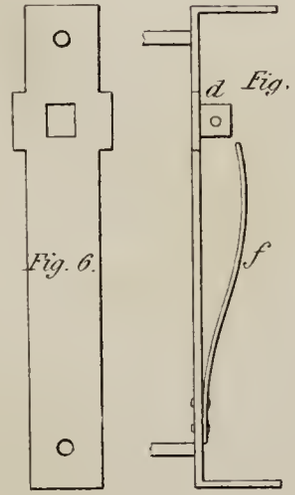



Fig 2.



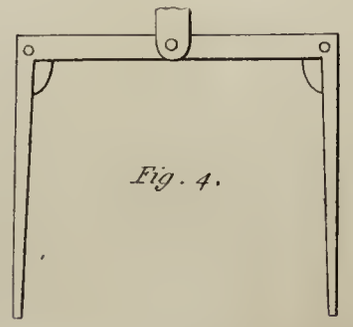



Fig. 4.

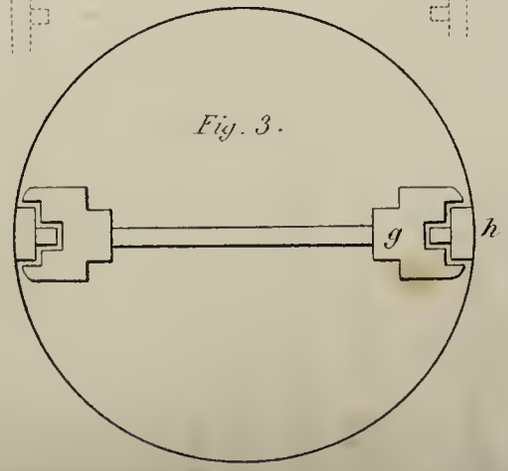


Fig. 7.

Drawn by J Newton.

Engraved by J.B.Taylor.

this state it is applied to a cavity countersunk in the head of the hammer, to which it adheres by means of the wax, and is thus preserved from the effect of wet. The touch-hole consists of a cylindrical plug screwed into the side of the barrel, and having a pin or nipple projecting from it at right angles: this pin is perforated in the direction of its axis, and thus forms a communication with the powder in the cavity of the plug. When, by the release of the tumbler, the hammer is let go, the countersunk cavity, containing the patch of detonating paste, strikes on the top of the pin of the touch-hole, the paste explodes, and communicating its percussion through the perforation of the pin, fires the powder in the cavity of the plug, and thus discharges the gun. The corrosive and deliquescent salt resulting from the decomposition of the detonating paste can act only on the hollow of the hammer, where it does no material injury, instead of soiling and occasioning damp in the touch-hole itself. Hence a lock on this construction hardly ever misses fire, and the discharge is remarkably rapid; both of them circumstances which very materially influence the success, and consequently the satisfaction of the sportsman.

The detonation is so powerful, that if a card be laid over the pin, or even if its perforation be stopped with tallow, the gun will, notwithstanding, be discharged. If the hammer is let down gently after priming, the spring presses the pellet close into the cavity, and thus considerably increases the effect.

The paste is made of the several ingredients in the following proportions, viz.

| | *Grains.* |
|---|---|
| Oximuriate of potash . . . . . | 196 |
| Flour of Sulphur . . . . . | 68 |
| Fine powdered charcoal . . . . . | 34 |
| Gum Arabic . . . . . | 12 |

Dissolve the gum in as little water as possible; then grind the oximuriate of potash fine, in a Wedgewood's mortar, by itself, and also the flour of sulphur and charcoal together, with a pestle of the same material. The mixture of all with the gum must then be effected, either in a wooden mortar with a wooden pestle, or, at any rate, in a Wedgewood's mortar with a wooden pestle, taking care to keep it moist during that operation, lest it should explode.

The paste, being of the consistence of soft clay, is then to be formed into pellets, by means of a mould, made of a plate of brass or copper, one-sixteenth of an inch thick, and filled with holes of one-eighth of an inch in diameter: this plate being placed upon a table, or other flat surface, over which a sheet of paper is first to be laid, the paste is to be spread evenly over its surface, and then pressed into the holes, either by passing a roller over it, or by beating upon it with a wooden mallet: the paste is then to be removed from the upper face of the mould, with a thin spatula or palette knife; and the mould is next to be slided, for the length of an inch, along the paper, to separate the paste from it; and it may then be lifted up, and the pellets carefully driven out of the holes in it, by striking upon it with a soft brush; they are then to be dried. The round paper patches being cut by a proper punch are covered on one side with bees wax mixed with a little tallow, and coloured red to distinguish the adhesive side from the other: the pellet is then gently pressed on the centre of the waxed side of the patch, to which it adheres, and the priming patch is thus completed.

When used, the patch is to be pressed firmly into the countersunk cavity of the head of the hammer, to which it easily adheres in consequence of its waxed surface being in contact with the metal.

The following recipe for the composition of the pellets has been communicated from another quarter.

Take oximuriate of potash 49 grains, flour of sulphur 17 grains, pulverized charcoal $8\frac{1}{2}$ grains. Mix the three ingredients in a wooden mortar, with a tea-spoon full of weak gum water, making it about the consistence of bookbinders paste. Have ready a piece of copper or brass plate, pierced with circular holes of one eighth of an inch diameter, lay it on a board, and spread the composition over it, so as to fill up all the holes. Allow twenty minutes for the paste to harden, push the pellets out with a wooden punch that fits the holes, and spread them to dry more completely, after which they may be fixed with any adhesive composition upon small circular pieces of thin paper for use.

Many testimonials in favour of Mr. C. Hall's invention from persons who had used it for some months, accompanied the original communication, but which it is not thought necessary to insert here. They remain, however, in possession of the Society, as also does a model of the lock.

*Explanation of the Figures.—Plate VIII.*

*a*, fig. 1, the lock-plate of a common gun, with the hammer and feather spring removed, and the screw holes plugged up; the pan also being filed off level with the lock plate and bevelled to drain the rain off.

*b*, the hammer placed on the axis of the tumbler in place of the cock.

*c*, a plug screwed into the breech where the touch-hole formerly was; which plug is perforated through its whole length at right angles to the axis of the barrel.

*d*, a small pin or nipple left on the plug, through which a hole is bored at right angles to the axis of the plug. The top of the pin is so placed as to strike directly on the centre of the priming patch in the head of the hammer, when the hammer is released, as shown by the dotted arc, *ff*.

*e*, a bush made of platina screwed into the end of the plug, and perforated by a capillary tube, in order to moderate the effect of the detonation, and thus prevent the powder from being blown out of the plug before it is ignited.

Fig. 2, is a front view, the barrel being cut off close to the plug.

Figs. 3, 4, are a lateral view and section of the plug.

Fig. 5, is a section of the hammer to show the cavity g, in which the patch is deposited.

Figs. 6, 7, a plan and elevation of the patch.

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## N° VI.

## MOORING BLOCK.

*The* GOLD MEDAL *of the Society was this Session presented to Mr.* J. PARK *of Portsmouth, for his* MOORING BLOCK. *The following communications were received from him on the subject; an explanatory engraving is annexed, and a Model of the Invention is preserved in the Society's Repository.*

Portsmouth-yard,
March 25, 1818.

GENTLEMEN;

I TRUST that the communication which I am about to lay before you will not be deemed altogether undeserving your notice.

In October 1795 I was appointed junior master attendant of Portsmouth yard, and as the security of his ma-

jesty's ships and all works on float, relative thereto are in the master attendant's department exclusively, I applied myself as much as possible to gain a thorough knowledge of the harbour, as well as of the nature of the security and disposition of the moorings, and the more I became acquainted therewith, the less satisfied I was with the method by which the ground chain was secured, as a national evil attended it, and various other inconveniences to the public service.

The evil alluded to was that of throwing some thousand tons of shingle ballast annually on what is called the *claws* of the moorings to render them secure, which ballast was by the wash of the tide carried into the bed of the harbour and lakes where the ships ride.

Having arrived at the head of my department in April, 1812, I ventured humbly to recommend to the honourable Navy Board, considerable alterations in the arrangement of the moorings, which would not only tend to improve the harbour by giving more space in the lower part, where the same was required for ships to pass and repass, but also afford accommodation to a greater number of them than hitherto could be laid up; the recommendation being favourably received, I was directed to proceed accordingly.

These alterations were effected, but the great and growing evil of filling up with ballast a harbour already too shallow, still continued, and produced an anxious wish for some substitute for the claw, by which the application of shingle ballast might be discontinued. I was accordingly induced to make several experiments, and after various trials, I submitted to the navy board a model of a cast iron Mooring Block which appeared to promise fair to do away every objection arising from the method of securing the ground chain, being at once a substitute both for claws and mooring anchors.

The Board directed two to be cast of such form and

weight as I wished, and when received in the yard, trials to be made to ascertain what degree of resistance they possessed.

When received, trials were made under the inspection of several experienced and distinguished naval officers, and the principal officers of the dock yard; which proving satisfactory, induced me to address the Navy Board on the 2nd November, 1814, detailing my sentiments, &c. relative to Portsmouth harbour, and the moorings, accompanied by accurate statements of the trials made with the blocks, copies of which I have annexed hereto, having first obtained the Board's permission to do so.

A trial being ordered on a lighter block, and proving equally satisfactory, directions were shortly after given for their general adoption, to the exclusion of every thing hitherto used for securing moorings, and a contract immediately entered into for the supply of them.

The superiority of the block in question over both claws and anchors is manifest, it will last for ages without repair, will resist much greater power than either, and completely obviate the use of shingle ballast, to render the mooring secure (which must hitherto have been extremely injurious to the harbour) as on applying a strain it has a tendency, arising from its form, to bury itself more and more under the surface until it becomes fixed; it is likewise free from liability to be hooked by ships' anchors, and the moorings thereby rendered insecure, which has been the case hitherto, as represented in my letter to the Board above quoted.

I now beg leave to notice the Mooring Blocks in an economical point of view.

The largest blocks, adapted for first-rates' moorings, are now supplied for less than half the sum required to provide and fix what is termed a claw, and about a quarter of the cost of a mooring anchor.

It must also be considered that both the anchor and

claw would require to be replaced in the course of 40 or 50 years (supposing them to remain undisturbed) besides which the claw would require frequent repair from the effect of the worm during that period.

On the blocks already laid down at this port (although principally as substitutes for claws) there arises a saving to the public of upwards of £.3,000; and where it may be necessary to lay them down instead of anchors, the saving will be infinitely greater.

It may not be amiss to mention that an opinion prevailed that the block invented by me was only an improvement on one invented by Mr. Hemmans of Chatham Dock-yard some years ago, but on an examination of the two by a committee of the Navy Board, the same was clearly proved to be erroneous: the report to the Admiralty on that subject, and recommending the general adoption of my block, was as follows, viz.:

"The Committee has further to remark, that Mr. Park's Block cannot be considered as an improvement on the plan of Mr. Hemmans, being totally dissimilar; but altogether as a new invention, and having the same object in view."

As a model and drawing of the block are forwarded, I decline giving any written description of it here, but should the Society require further particulars, I shall have much pleasure in furnishing them.

I have only now to observe, that having been influenced by a strong sense of public duty, and an ardent desire to be useful to my country by overcoming the serious evils set forth in my narrative, I trust it will not be considered too presuming to request as a mark of your approbation that you will be pleased to give my invention publicity.

I am, Gentlemen,

*A. Aikin, Esq.*
*Secretary, &c. &c.*

&c. &c. &c.
J. PARK.

*Copy of a Letter addressed to the Hon. the Navy Board.*

Portsmouth-yard,
Nov. 2, 1814.

HONOURABLE SIRS;

HAVING from my first appointment to Portsmouth yard as junior master attendant, dedicated as much time and attention as in my power towards acquiring a thorough knowledge of the harbour, both as to the depth of water and quality of the ground, and also to the method of preparing and laying down moorings, together with any improvements that might be made, either for their security or for increasing their numbers by a more advantageous arrangement, or by laying down additional ones where found practicable.

I have in the course of my practice (which has been now upwards of 19 years), experienced many inconveniences, which I have long conceived might be removed by making some alteration in the manner of securing the ground chain.

I have likewise been of opinion from an early period after my appointment that many advantageous alterations might be made among the moorings in various parts of the harbour, as well as that new moorings might be laid down both for ships of the line and frigates in the different lakes, and having submitted the same to your Honourable Board by letters of the 30th April, 1812, and 26th July, 1814, was directed by your warrants of the 8th May, 1812, and 28th July, 1814, to carry the propositions into effect: in consequence of which, several alterations have been made, and many new moorings laid down, and much may yet be done when the other duties of the port will admit; but as I am preparing a plan of the harbour, which will show the alterations, &c. much plainer than any written description, I shall decline saying more at present, and endeavour to describe the manner of securing the ground chain, with the inconveniences alluded to.

The ground chain of all the swinging moorings in the harbour is secured as follows:

One end is fixed to what is termed a claw, namely, a frame of wood, with an iron ring in the front for shackling the chain to, which claw is buried below the surface from 2 to 3 feet, by digging away the mud or ground as near the low water mark at spring tides as circumstances will admit, with piles driven in the front, and when completed, the mud which has been removed is thrown on the claw so as to cover it.

The other end of the chain is secured by a mooring anchor, namely, two anchors of about 70 cwt. each, in one stock, with their upper hooks either taken off or beaten down on the shank; this is for line of battle ships moorings; frigates moorings have only one anchor of about 60 cwt.

From this harbour having for some years become a rendezvous for ships in the transport service, and thereby crowded with ships of that description, together with the liability of the mooring anchors, from their construction, to be hooked by the transports anchors, much inconvenience, labour and risk have been experienced, and many instances have occurred when it has been necessary to take up a mooring from end to end, in consequence of ships having hooked the mooring anchor, and regardless of every thing but the recovery of their own anchors, have hove down unobserved in the night-time at low-water, and by the rise of tide, forced the mooring anchor out of the ground; nor did I ever find one so displaced when taken up, entire; but, on the contrary, one anchor has been lying across the other, the stock broken or gone, or the chain foul of the flooks, and I have seen instances when the mooring anchors have been completely upset and found with the flooks uppermost. Having described the swinging moorings, and also what I humbly consider

objections to the anchors, and the principal inconveniences arising therefrom (I say principal, because there are others, particularly where the anchors lie in shoal water, the frequency of their being injured by ships grounding on them, &c.)

I have now to state that all the head and stern moorings in the different lakes are secured by claws only, the chain being laid from shore to shore, and each end shackled to a claw; this method of securing the chain is not however in my opinion, without objections, and to which I humbly call the attention of the Board.

Notwithstanding the claws are perfectly buried when laid down, yet in the course of twelve months they appear above ground, and frequently require a supply of shingle ballast to be thrown on them, particularly in the lakes where the stream is narrow; and as the disappearance of this ballast can only be accounted for, by its being washed down by the tide into the bed of the harbour and lakes, I cannot divest myself of the opinion that the same must prove detrimental to the harbour.

These considerations induced me to search for a substitute, free from such objections, to answer the purpose either of the claw or the anchor, and after making various trials I submitted for the inspection of the committee of your Honourable Board, who visited Portsmouth in September, 1813, the model of a cast iron block, when they were pleased to give directions for two being provided, and your Honourable Board have also directed, by warrant of the 6th July last, the two blocks to be received and tried; they have accordingly been received, and trials made with every possible power, applied to ascertain their stability; and as every one who has witnessed the experiments is fully convinced of the superiority of the blocks, I trust I shall not be considered too presuming in recom-

mending their adoption for claws as well as anchors, as I am given to understand the cost will not much exceed the expense of making and fixing a claw, which is liable to injury, by vessels grounding on, or hooking fast to it, nor is its durability beyond 40 or 50 years, even where it remains undisturbed, whereas the cast iron blocks will last for many centuries.

I am likewise informed that the Blocks may be cast at the foundry, in the yard, if your Honourable Board should approve of a furnace being erected for that purpose, which would materially lessen the expense.

I have hereunto annexed a description of the trials, and and have forwarded by this night's coach, two drawings.

No. 1, showing the present method of securing the ground chain.

2, showing the manner in which the Mooring Block was tried.

And by Clark's waggon, a model of the Block.

I am, Sir,

&c. &c. &c.

J. PARK.

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*Description of the Trials made with the Cast Iron Mooring Block, invented by me, and now humbly submitted for the consideration of the Honourable Navy Board.*

FIRST, The Cast Iron Mooring Block, weighing 142 cwt. was placed on the shore some distance from low water mark, and an anchor of 85 cwt. (exclusive of the stock, which weighed about 35 cwt.) was also placed the same distance from low water mark, and 65 fathoms from each other, on ground of the same quality; 15 fathoms of mooring chain were attached to each, and to the end of each chain four treble blocks of 22 inches; four three-

fold purchases of new 6 inch hawser rove, and two mooring lighters, with 40 men in each, grounded, one abreast of the cast iron block, and the other abreast of the anchor; the falls were brought to the capstans and windlasses, and the strain applied to heave the Mooring Block and anchor towards each other.

Both drew; the former one inch to one foot of the latter, until the Mooring Block had drawn about the distance of its own base, when having completely buried itself, it became stationary, but the anchor continued to come home (notwithstanding it was buried to the upper flook) until every one present was satisfied that any farther trial with an anchor of that weight was useless.

Second, being willing to make further trial, I caused an anchor of 95 cwt. (namely, the Nelson's best bower) to be laid down as before, and the same purchase to be applied; but the power not being sufficient to move either the block or anchor, 10 additional men were sent into each lighter, when the anchor started, and continued drawing, notwithstanding it soon buried itself as the former had done) but the Block remained immoveable.

Although this trial was very satisfactory, yet wishing to ascertain the power of resistance which the Block possessed, I caused the following one to be made.

Third, an anchor of 41 cwt. was laid down about 60 feet behind the large anchor, and attached to it by cable, and on applying the same purchase as above, the large anchor drew until the cable between the anchors became taught, when it was found necessary to increase the power, which, being done, both anchors started, and continued to come home, until the superiority of the Mooring Block (which still remained firm) was declared to be so manifest, that no further experiment was necessary, it being the opinion of the gentlemen under whose inspection this last trial was made, viz. Admiral Sir Richard Bickerton,

baronet; Rear Admiral Foote; Commissioner the Hon. Sir George Grey, baronet; Captain Sir James Athol Wood Hewit, and the principal officers of the Dock Yard; —that it was much superior to any thing yet offered for the purpose of securing the ground chain of the moorings, and that its introduction would prove advantageous to the service, particularly in shoal water where ships had to pass over the anchors.

J. Park.

*Statement of Trials made with a lighter Cast Iron Mooring Block.*

First, the Mooring Block weighing 115 cwt. was placed on the shore near low water mark, and also an anchor of 95 cwt. (exclusive of the stock) about 65 fathoms from each other, with 15 fathoms of mooring chain attached to each, and to the end of each chain 4 treble blocks of 22 inches, 4 three-fold purchases of new 6 inch hawser rove, and 2 mooring lighters, with 50 men in each grounded, one abreast of the Mooring Block, and the other abreast of the anchor; the falls were brought to the capstans and windlasses, and the strain applied to heave the Mooring Block and anchor towards each other (similar to the trials made with the former block, a statement of which accompanied my letter of the 2nd of November last).

The block and the anchor both drew about the distance of seven feet, when the block became fixed, but the anchor continued to draw as long as the purchase was applied.

Second, an anchor of 43 cwt. was laid down about 10 fathoms behind the large anchor, and attached to it by cables (termed by seamen, "backing an anchor") when the purchase was again applied by 64 men in each lighter: the large anchor drew, taking the small one with it, until the latter had buried itself up to the crown, when the

anchors became stationary, and the block began to draw, and continued to do so while the strain was applied.

Third, having removed the anchor of 43 cwt. and laid down one of 23 cwt. instead, at the distance of 15 fathoms behind the large anchor, the same purchase was again applied, when both anchors came home.

The block, after having drawn about 7 or 8 inches, became fixed, but the anchors had drawn 13 feet, and kept coming home as long as the purchase was continued, and until it was evident that the block was superior to the anchors.

The foregoing trials were made under the inspection of Admiral Sir Edward Thornbrough, K. C. B.; Rear Admiral Halkett; Commissioner the Hon. Sir George Grey, bart.; Captain Hewitt; the Master Shipwright, Master Attendant, Engineer and Mechanist, &c. &c. &c.

J. PARK.

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*Reference to the Engraving of Mr.* J. PARK'S *Cast Iron Mooring Block,* Plate VIII.

A A A A, the extent of the lower flat of the block.

B B B B, the extent of the upper flat.

C C, for lowering the block into its place.

D, the neck of the block, to which the chain is attached.

E, the shackle which connects the mooring chain to the block.

*Side View.*

F G gives the block an inclination to dive into the ground, when strain is applied.

# Mr C. Halls, Percussion Gun Lock. Pl. 8.

Fig. 1.

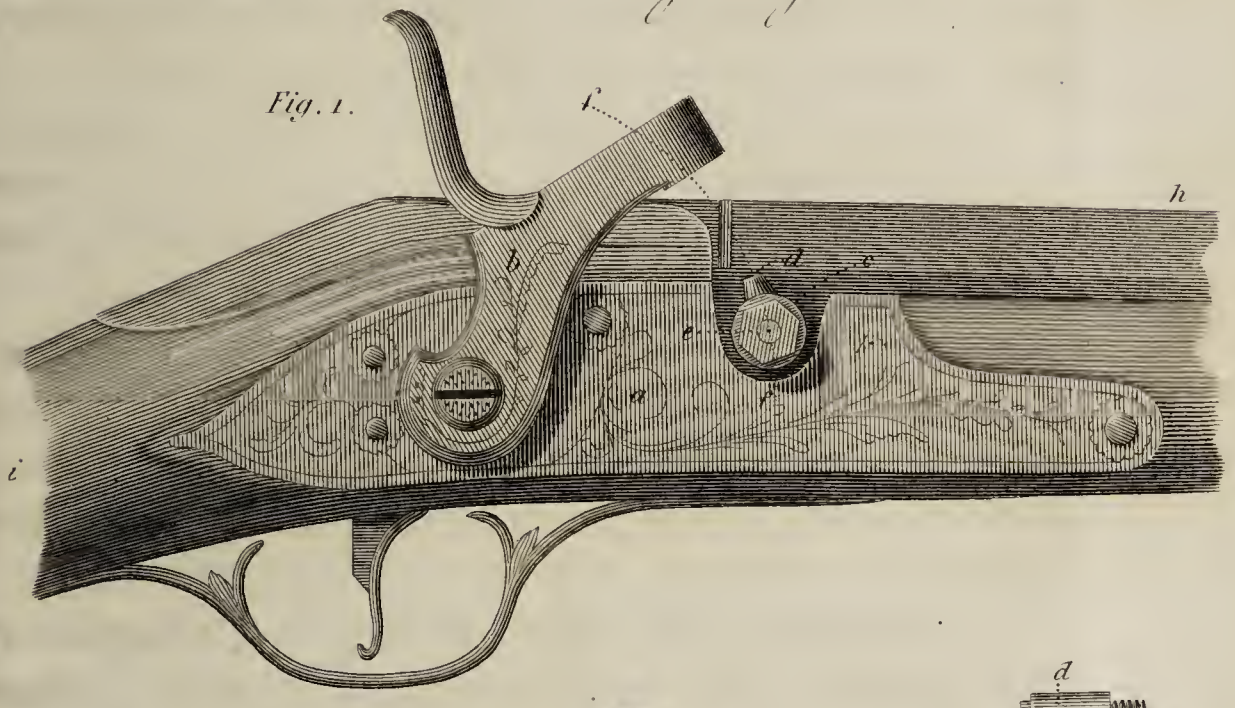


Fig. 3.

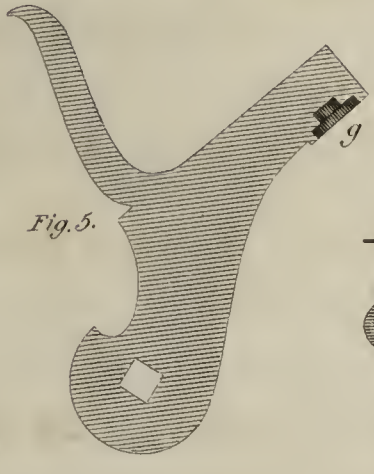



Fig. 5.

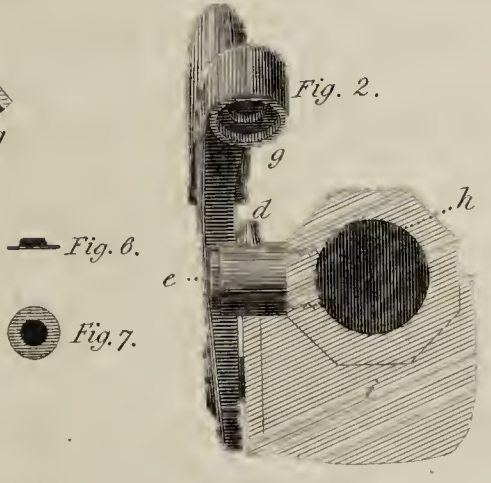



Fig. 2.



Fig. 6.



Fig. 7.

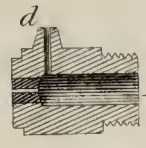



Fig. 4.

# Mr I. Parks, Cast Iron Mooring Blocks.

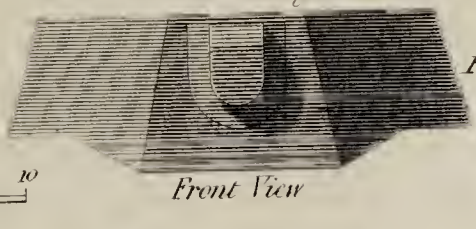


Fig. 9.

Front View

Scale of Feet

1 2 3 4 5 6 7 8 9 10

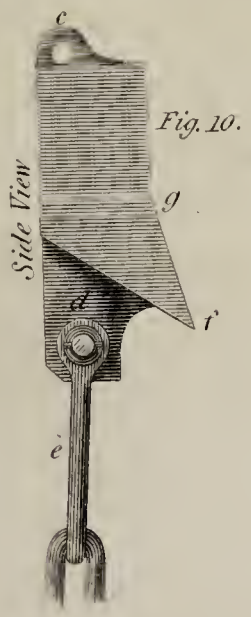



Fig. 10.

Side View

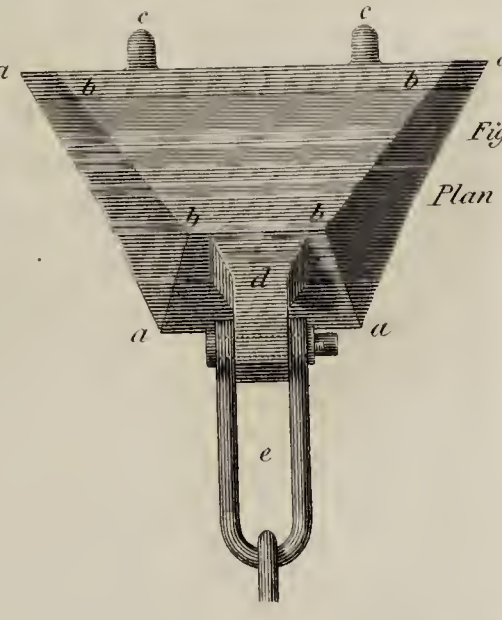



Fig. 8.

Plan

Drawn by W. Newton.

Engraved by G. Gladwin.

## N° VII.

## IMPROVED METHOD OF HEATING COPPER PLATES.

*The* GOLD ISIS MEDAL *was this Session presented to Mr.* JAMES RAMSHAW, *Copper Plate Printer, Fetter Lane, for an* IMPROVED METHOD OF HEATING COPPER PLATES. *The following communication was received from him on the subject, and Drawings of his Invention are preserved in the Society's Repository.*

33, Fetter Lane, Fleet Street,
March 10, 1818.

SIR:

I BEG leave, through your hands, to present for the approbation of the Society of Arts, &c. a representation of my Apparatus for an improved Plan of Copper Plate Printing, by the use of steam in the place of charcoal fires, the effluvia of which are so injurious to the health of the work-men, and at the same time subject to many accidents by fire, as by the old process, each man works over a charcoal fire, without any chimney to carry off the vapour arising from the burning charcoal. Thirteen of those fires I formerly had in my work-shops, and one sea-coal fire or stove in my drying room, fourteen fires in the whole: by my new process, the use of the thirteen charcoal fires is superseded. A full representation of the apparatus, with the mode of application, will be given by referring to the accompanying drawing, which is a section of my premises, employed in the Copper Plate Printing

business. A, Plate VII, is the fire-place; B, a small boiler, containing only thirty gallons of water, with two safety-valves; C C C, are the pipes for conveying the steam to the plate boxes, D D D; these boxes are of cast iron, thirteen in number, and supply the place of thirteen charcoal fires; they have a flat surface, 16 inches square, half an inch deep at the sides, running to three inches in the centre, thus leaving a fall for the water to run as the steam condenses; these boxes are particularly convenient for the workmen, as they turn out their work much cleaner than by the usual process, not having to attend to their charcoal fires. Another advantage is, that injury to the health of those employed is thus prevented, as every person must be convinced of the unhealthy state of rooms where charcoal is burning in open pots, without flues, from which both noxious fumes and particles of fine dust are continually escaping. Of these boxes I have introduced three only in the drawing, thinking them sufficient for explanation; but I should be very happy to attend the Society at any time to give any farther explanation that may be required. E E, I call the drums, the first I had made being of that form; it is a double cylinder of metal, with spaces of half an inch for the steam to pass through; by this means, the cylinder becomes heated, and the air passing through the centre, also becomes heated to any degree required for drying the goods. G is a vessel in which the steam from the drum E is condensed; H is a cistern, supplied with water by means of the pipe on the right hand, for the purpose of affording water by the pipe I, to the boiler; the water collected in the condenser is also discharged into the same pipe, and a stop-cock from which furnishes water to the open cistern J.

Another use to which the stove is put, is that of throwing hot dry air into the drying room, and extracting the damp air. The apparatus which performs this latter office,

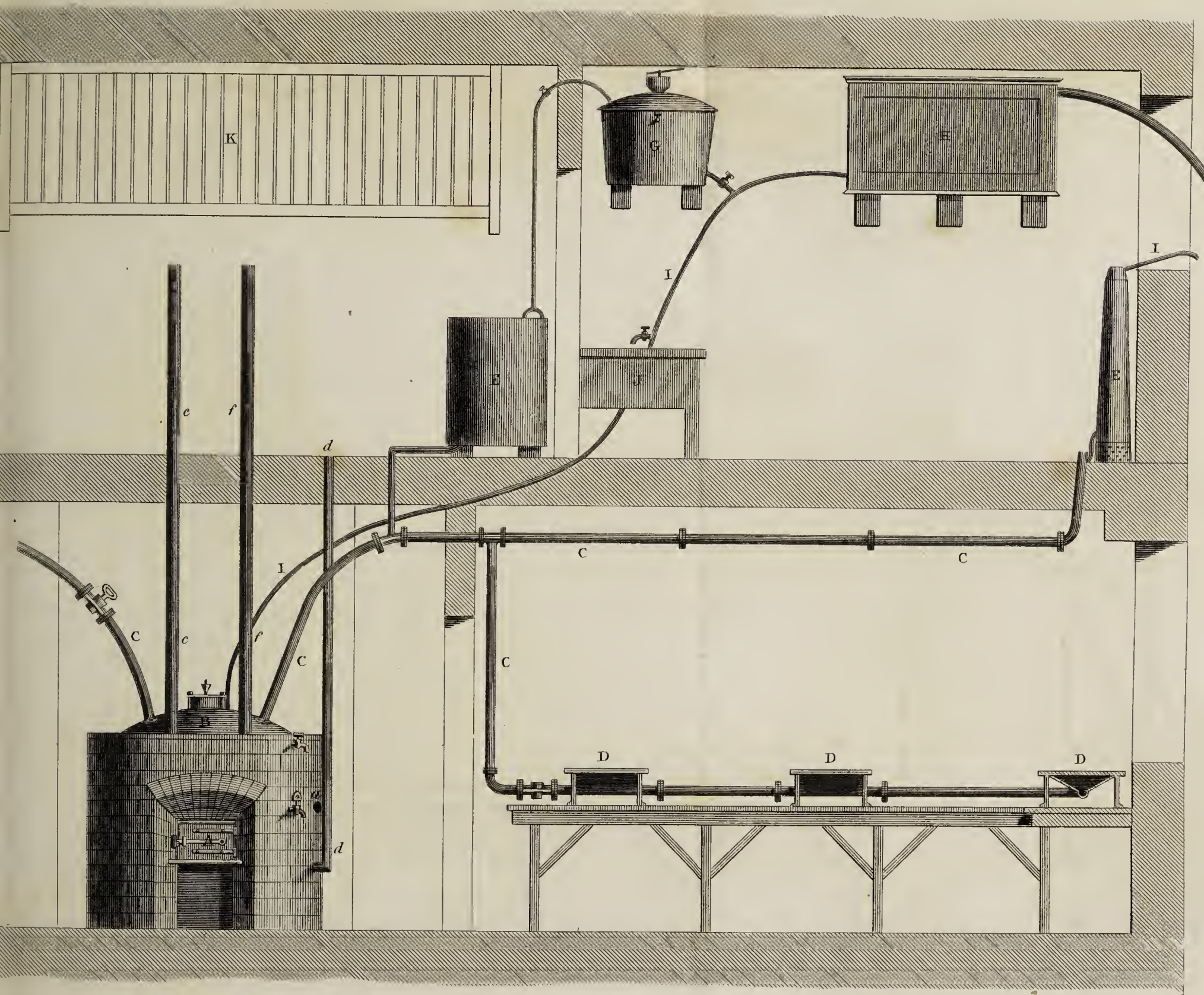



Fig. 3.

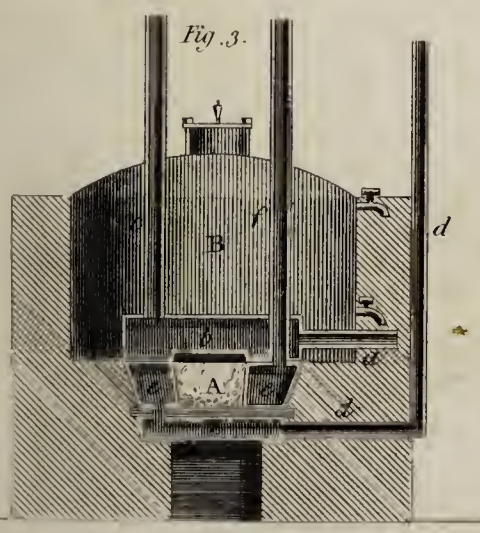



Fig. 4.

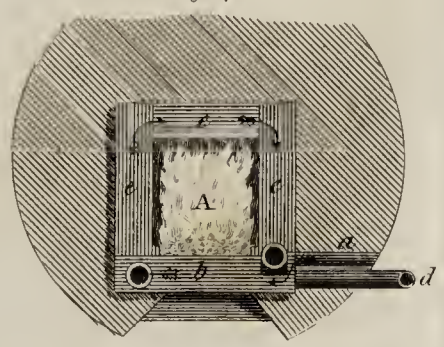
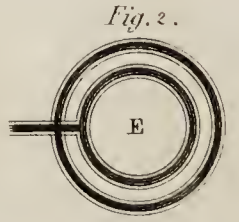



Fig. 1.

Fig. 2.



Drawn by W. Newton.

Engraved A.W. Warren.

# Mr. Ramshaw's apparatus for heating Copper Plates. Pl. 7.

Fig. 5.

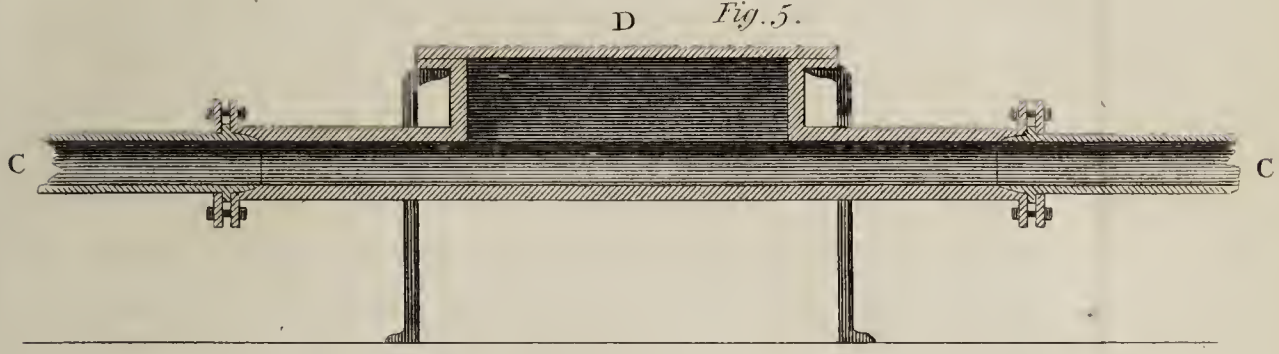



Fig. 6.

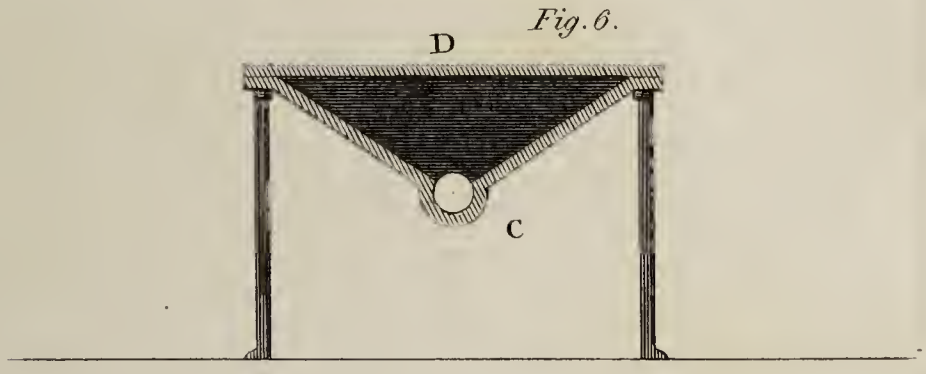



Fig. 10.

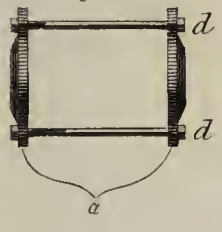



Fig. 11.

Fig. 8.

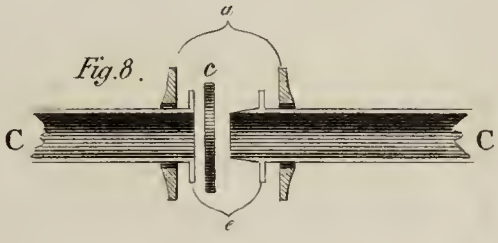



Fig. 9.

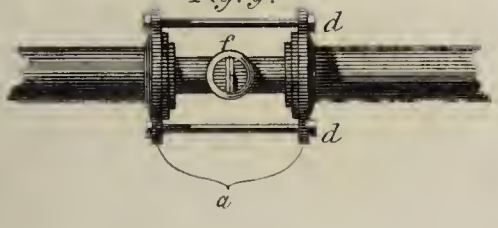



Fig. 7.

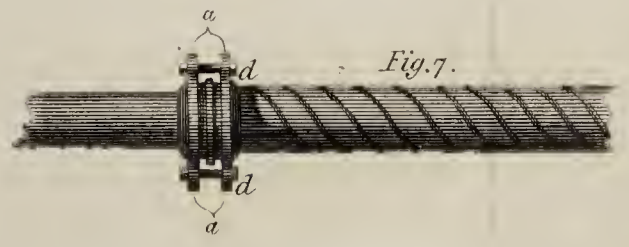



Fig. 12.

Fig. 13.

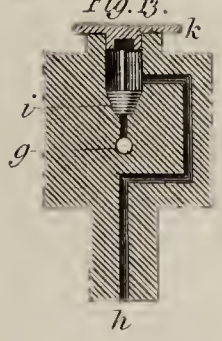
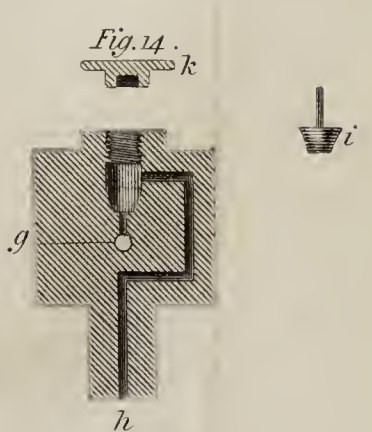



Fig. 14.




Drawn by W. Newton.

Engraved by A.W. Warren.

acts on the principle of the reversed syphon; *a*, is an open aperture in the side of the stove, fig. 3, which admits the external air into a cast iron box *b*, which surrounds the upper part of the fire: here the air being heated, passes into the drying room through the tube *c*. When cooled and saturated with moisture from the wet paper in the rack K, it falls through the tube *d* into the boxes *e e*, which surround the lower part of the fire, and being thus again heated, rises up the tube *f*, into the drying room.

Fig. 4 is a plan of the stove for the purpose of showing the boxes of cast iron surrounding the fire-place. Figs. 1 and 2 are a section and plan of the drum E.

Plate VI, fig. 5, represents a section of the heating plate D, and of the steam pipe C, to show the manner in which they are connected.

Fig. 6 is a section of the steam-box at right angles to the former section, showing the form of the box.

Figs. 7 and 8 are a view and section of the method by which two pieces of steam pipe are joined together; *c* is a washer interposed between the two shoulders, in order to prevent the escape of steam, and on the outside of the two shoulders are two flanches, through which the screws *d d*, fig. 7, pass, and thus secure the joint.

Figs. 9, 10, show the method of joining two pipes with an interposed stop-cock *f*, fig. 9. Fig. 10 shows the flanche with the hole C, through which the steam pipe passes, and the holes *e e* for the screws or bolts *d d*.

Figs. 12, 13, 14, exhibit a view and section of a valve fixed at certain distances, in the steam pipe, for the purpose of admitting the external air, when the condensation is greater than the supply.

I am, Sir,

*A. Aikin, Esq.* &c. &c. &c.

*Secretary, &c. &c.* JAMES RAMSHAW.

## N° VIII.

## PORTABLE TELEGRAPH.

*The* SILVER MEDAL *was this Session presented to* J. CONOLLY. *esq., Suffolk Street, Charing Cross, for a* PORTABLE TELEGRAPH, *and a printed Essay in explanation of it. A Model of the Telegraph, and a Copy of the Essay are preserved in the Society's Repository.*

MR. CONOLLY'S Telegraph is intended for land or sea service, and consists of four pieces. Three of these are square boards, *a, c, e,* fig. 1, plate IX, consisting of a black figure on a white ground, and having on the reverse of each the same figure in white on a black ground, as *b, d, f.* Each of these figures admits of being varied in four different ways by bringing each side of the square in its turn nearest to the ground. Hence each board gives eight different exhibitions, and the three boards of course give 24 exhibitions; a number amply sufficient for alphabetical communication. The other piece is a paddle shaped board, white on one side (fig. 3), and crossed by two black bands on the reverse (fig. 4) the former of these furnishes the affirmative, the latter, the negative sign.

If, instead of communicating alphabetically, a numerical vocabulary is preferred, then one of the square boards, the crescent for example (fig. 2), furnishes 8 digits, and he signals for 1 and 2, with the white paddle placed below, furnish the two other digits.

The printed essay contains a numerical vocabulary in most of the languages of Europe, consisting of 72 questions and answers, particularly adapted to the maritime merchant service.

The signal boards are 18 inches square, that size having, by experiments tried at Chatham, been found sufficient for a distance of two miles, when a telescope, with a magnifying power of 25 is made use of. Mr. Conolly has also exhibited these signals between Gros-Nez and Sarque, a distance of 17 miles; but in this case boards 12 feet square were employed.

The simplicity, cheapness, and portability of the invention, may, it is hoped, render it of use in many cases where telegraphs of a more complicated construction and less portable are not admissible, particularly in the merchant sea service, and in active military operations on shore.

## N° IX.

## PLUG FOR RAISING EMPTY CASKS.

*The* SILVER MEDAL *was this Session presented to Lieut.* W. RODGER, *R. N. for a* PLUG FOR RAISING EMPTY CASKS. *The following communications were received from him on the subject, and a Model of the Instrument is preserved in the Society's Repository.*

South Street, Sloane Square,
January 21st, 1818.

SIR;

I BEG leave to submit to the Society for the Encouragement of Arts, Manufactures, and Commerce, the model of an Expanding Plug (on a scale of half an inch to an inch of the full size) for lifting empty casks, in lieu of a hook, which is very injurious to the bung-stave.

I have already had the honour of submitting it to my Lords Commissioners of the Admiralty, who were pleased to order the guardships to be supplied with them for a trial of six months. The instrument is likewise under trial on board his Majesty's ships Semiramis and Sybille.

How far it has answered the intended purpose, will appear from the certificates I have herewith the honour to transmit.

Should the Society think the invention worthy of their notice, I shall feel much pleasure in waiting upon the Committee to give any explanation they may require.

I am, Sir,

*A. Aikin, Esq.*
*Secretary, &c. &c.*

&c. &c. &c.

WM RODGER

‖

Accompanying Lieut. Rodger's letter, are copies of certificates strongly in favour of his invention, after trial of the same, sent from

P. B. Pellew, *Captain, of H. M. S. Impregnable.*
Henry Crace, *Senior Lieutenant, Do.*
John Gage, *Master, Do.*
C. Ekins, *Capt. of H. M. S. Superb.*
James Walker, *Capt. of H. M. S. Northumberland.*
A. C. Dickson, *Capt. of H. M. S. Rochfort.*
E. Boyer, *Captain of H. M. S. Queen Charlotte.*
R. Ward, *Lieut. of Do.*
T. Alexander, *Capt. of H. M. S. Vengeur.*

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*Reference to the Figures of Lieut.* Rodger's *Plug, Plate IX.*

Figs. 5, 6, 7, 8.

*a*, a ring to which the rope is fastened, as shown fig. 13.

*b*, a bolt of a cylindrical form, but extending at its base into a cone. The ring *a*, passes through the upper part of the bolt.

*c c*, four segments embracing the cylindrical part of the bolt, and tied by the ring *d*, so as to keep them in their places, with regard to each other, yet to allow them (together with the cap *e*, fig. 6) to slide readily on the cylindrical part of the bolt.

To apply the instrument, grasp it by the ring *d*, and introduce it into the bung-hole, then let go the ring, and the moveable parts will slip down till they are stopped by the conical termination of the bolt. At the same time, the loose ends of the segments *c*, will be expanded, so

that on drawing the rope tight, the shoulders of these segments will be fixed on the under side of the bung stave, pressing equally all round the bung-hole, and thus preventing any injury to the stave, from the weight of the barrel while it is suspended on the rope.

Fig. 5, the instrument ready to be introduced into the barrel.

6, shows the moveable parts in a state of expansion, when they are supporting the barrel.

7, a section of the ring and bolt.

8, shows how the moveable parts arrange themselves about the conical end of the bolt.

Figs. 9, 10, a back and front view of one of the segments.

11, the ring.

12, the cap.

13, the instrument in use.

# Mr Conolly's, portable Telegraph. Pl. 9.

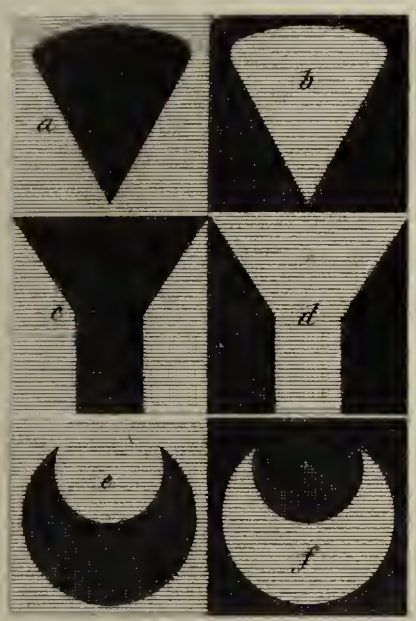
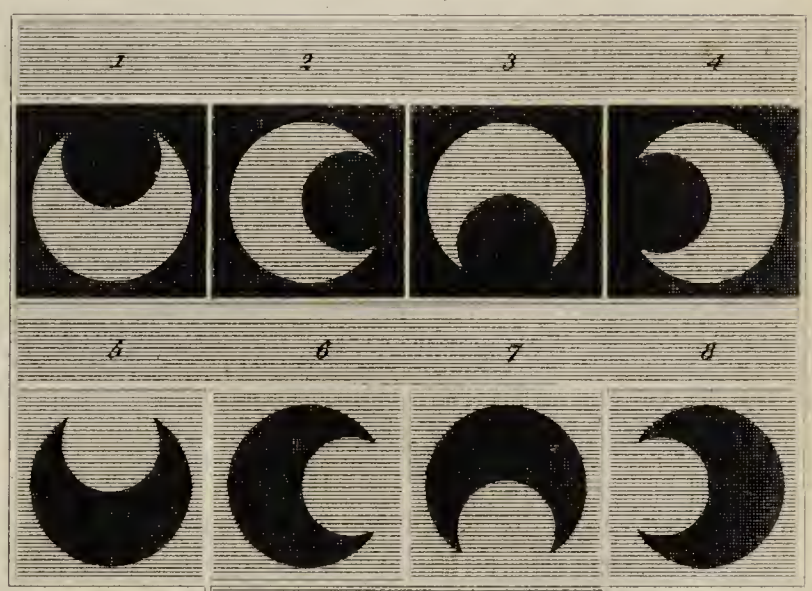



Fig. 1.



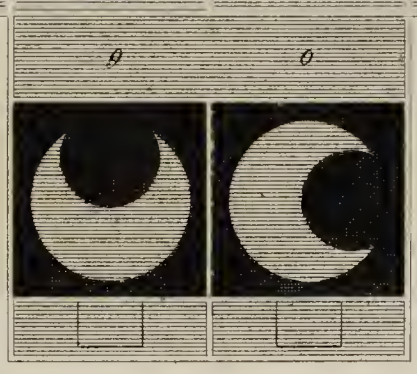




Fig. 2.

Fig. 3.

Fig. 4.

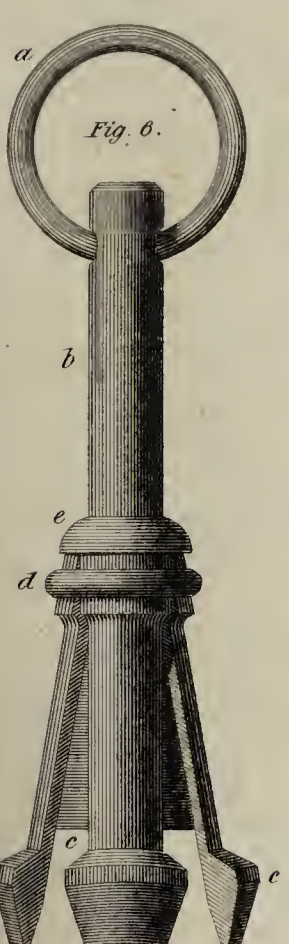



Fig. 6.

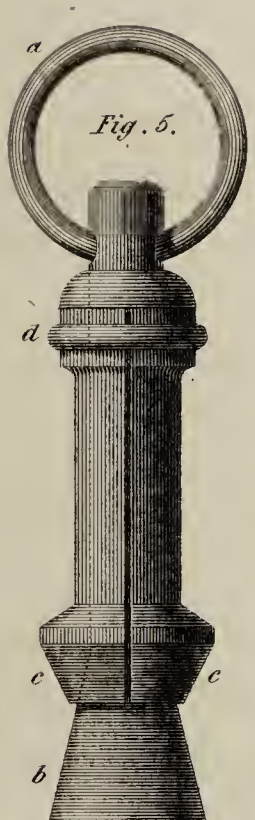



Fig. 5.

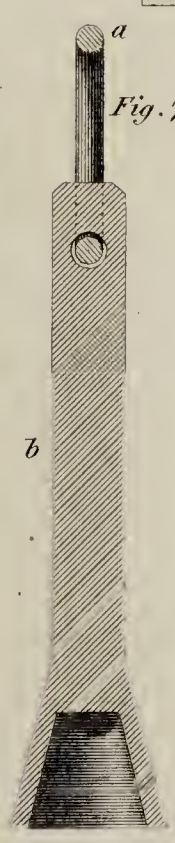



Fig. 7.

Fig. 9.

Fig. 10.

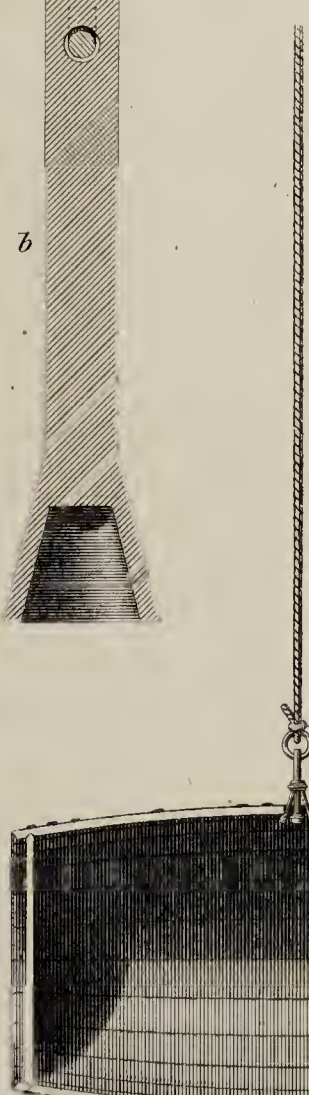


Fig. 13.

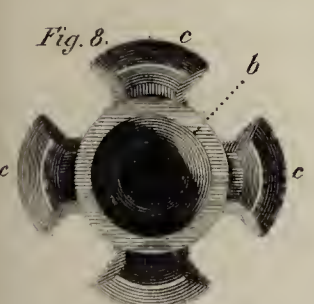



Fig. 8.

Fig. 12.

Fig. 11.

Drawn by M.A. Nicholson.

Engraved by G. Gladwin.

Lieut. Rodger's, Plug for raising empty Casks.

## N° X.

## IMPROVED PULLEY BLOCKS.

*The* SILVER MEDAL *of the Society was this Session presented to Mr.* JAMES JONES, *of No.* 150, *High Holborn, for* IMPROVED PULLEY BLOCKS. *The following communication was received from him, and Models of the Blocks are preserved in the Society's Repository.*

No. 150, High Holborn,
Feb. 11, 1818.

SIR;

HAVING effected what I conceive to be an improvement on the usual combination of Blocks, I beg leave to submit the same to the inspection of the Society for the Encouragement of Arts, Manufactures, and Commerce.

I am, Sir,

*A. Aikin, Esq.* &c. &c. &c.

*Secretary, &c. &c.* JAMES JONES.

In offering to the consideration of the Society a subject so immediately connected with the operations of many practical arts, as an improvement in the combination of tackle blocks; the extent of their application in all cases where the use of more complex machines cannot, for many reasons, be adopted, will, I trust, be sufficient apology for this communication.

The almost unlimited use of blocks (arising from their simplicity, portability, and power) is, I think, ample reason for attempting to improve an agent of so much

utility; and, indeed, the many persons who have turned their attention to the subject, sufficiently prove the importance of it.

The imperfections of common blocks are so well known to all persons who are in the habit of using them, and are, in fact, so obvious to the most cursory observer, that it would be superfluous to mention them, but that it is necessary to state the evil I would propose a remedy for. When there is more than one sheave in the same block, the fall or end of the rope to which the power is applied, comes last over the outside sheave; and that sheave, if the exertion of the power is in a line nearly parallel to the direction in which the load is drawn, always endeavours to get into a line with the point of suspension, and the place where the power is exerted. For, the great friction to be overcome, preventing the equal transmission of the power throughout the combination, and the outside sheave having to sustain, not only the pressure of its own share of the load, but the additional strain sufficient to overcome the friction of all the other parts of the blocks, and the *vis inertiæ* of the entire load; it must, therefore, be considerably depressed, and in consequence of this oblique direction of the block, the lateral friction of the sheaves becomes so great, as in some cases nearly to equal the power.

Again, if the tackle-fall is drawn in a direction, making a considerable angle with that of the load, the sheave it passes over, tends very powerfully to get into a right line with the point of suspension and the power as before; but in this case, the ill-effects are of rather a different kind; for although the block is not so much depressed on one side as in the other case, it does not face the pull; that is, the axis of the sheaves does not stand at right angles with the fall, but is considerably twisted from it, and consequently the rope suffers violent friction and wear

against the edge of the cheek of the block. And as the evils here pointed out, are rapidly increased by the extension of the combination, it is not surprising that the multiplication of pulleys thus used, soon ceases to be advantageous.

The first (and indisputably the most effectual) attempt to remove the imperfections of the common method of combination, was that of the celebrated Smeaton, who brought the fall through the middle sheave by means of double tiers; but as his arrangement does not apply to any combinations of less than twelve, as such great strains are not frequently required, and there is considerable loss of height, it is, though so perfect in itself, very seldom used.

The next was, I believe, Garnet's patent method of avoiding friction, by the introduction of friction rollers into each sheave; but this plan being expensive, soon out of repair, and not tending to remove the imperfection of lateral drag or twist by any change in the combination, did not come much into use. Then followed White's patent concentric pulleys, which, having the same tendency to drag on one side as the common blocks, laboured under the same difficulties, namely, great lateral friction and obliquity of draught; to which may be also added, a great increase of friction, arising from the speedy loss of the relative proportion of the diameters of the several grooves, occasioned by the stretch and wear of the rope. Thus, suppose we take a rope of an inch diameter, which being added to the several grooves in the top sheave (for instance) shall with its respective groove give the proportionate compound diameters of 2, 4, 6. That is a 3 inch groove, with the semi-diameter of the rope on each side is four inches; a 7 inch groove with its rope is 8 inches, and an 11 inch groove, with its rope, is 12 inches. Now, supposing the rope to stretch and wear so much as to

reduce it to 0·8 inch, the proportion of the respective compound diameters will then be 2, 4·105, 6·210, being 3·8 inches, 7·8 inches, and 11·8 inches, whereas, to preserve the just proportion, they ought to be 3·8, 7·6, and 11·4 inches, that is, as 2 : 4 :: 3·8 : 7·6, and as 2 : 6 :: 3·8 : 11·4. Thus the proportion of the grooves is entirely lost, the second one being 0·2 inch, and the third one 0·4 inch too large; and consequently in use, all the grooves except the largest both in the top and bottom blocks (for they are equally affected by the diminution of the diameter of the rope) must revolve so much slower than the rope which passes over them, as to create an immense accession of friction, thereby adding greatly to the load, and very speedily wearing out both blocks and rope. These are imperfections of such magnitude, that no one can be surprised at the discontinuance of their use. The last improvement is that of Lieut. Shuldham, and consists of White's pulley doubled, base to base, with two friction wheels in the cheeks of the block, for the axis of the compound sheave to revolve on, but on which it would be highly improper in me to make any comment whatever.

These are, I believe, the only means that have ever been proposed to improve this useful agent; and as a variety of means of effecting any particular purpose is at all times desirable to afford an opportunity of adopting that which is most applicable to the particular occasion, I trust the method I have now to propose of lessening some of its imperfections may be found sufficiently effectual to merit the attention of the Society.

Previous to describing the improvement I have adopted, it perhaps may not be deemed impertinent to mention the circumstances which gave rise to it. I had a small piece of machinery which I was desirous of keeping in motion by the action of a descending weight attached to a pair of common jack blocks, but the imperfection constantly

attendant on wind-up jacks, prevented the due effect; for the weight which, by calculation, ought to have been sufficient for the intended purpose, would scarcely keep it in motion; I therefore turned my attention to the improvement of the blocks, and adopted that shown in the model, which proved as effectual as I could wish; for the same weight with the same blocks (having undergone the necessary alteration) kept the machine in rapid motion. Having thus succeeded, I was afterwards much gratified to find that my combination was the same in effect as Smeaton's (for at the time I was engaged in the improvement, I was perfectly ignorant of the arrangement of that eminent engineer), the fall in the method I have adopted passing immediately under the point of suspension, as in his, effectually preserves the perpendicularity of position; but the transfer from the one side to the other, I have effected by the intervention of only one sheave, instead of the six (at least) employed for that purpose by Smeaton. Thus affording a means of acquiring the good effects without the necessity of employing so great a number of sheaves as the before-mentioned combination requires; and consequently rendering them simpler, and more applicable to general purposes where such great power is not frequently required.

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*Reference to the Engravings of Mr.* J. Jones's *Blocks.*

Plate X, fig. 1, is a perspective view of a pair of iron blocks of seven sheaves, of which fig. 2 is a section, and fig. 3 is a front view of the top block.

It will be seen that the rope is tied to one of the partition plates in the bottom block at A, from whence it passes over the outside sheave at top, under the outside sheave at bottom, from whence it is transferred over to the other side by means of the cross sheave B, at

top; it then descends to the outside sheave at bottom, turns up to and over the outside sheave at top, under the centre sheave at bottom, and from thence comes out over the centre sheave at top, and consequently has no tendency either to twist or to drag on one side.

C is a thin rope or line attached to a bent wedge or gripe D, which lies on the fall in the centre sheave (as is seen more distinctly in figs. 2, 3), for the purpose of retaining the load, if the fall is let go, either by accident or design; it is evident that on the return of the fall, the wedge (if not held back by the small rope C), will be carried in by the fall, and by taking its bearing against the collet E, jam it so fast against the sheave, as to retain it in opposition to any endeavour to draw it through. The fall may be instantly released, and the load lowered by drawing the fall just sufficient to liberate the wedge, which may then be held back by the line C passing over the small roller F, and might be drawn entirely out of the block, but for the pin G inserted into the wedge, and which stops against the collet E.

Fig. 4 is a front view of a pair of wooden blocks of four sheaves (being the lowest combination of which this method is susceptible), and fig. 5 is a horizontal section of the lower block, showing the angular direction of the two sheaves, which in this case is requisite, to avoid the necessity of making the cross sheave so small as would be extremely detrimental to their action. The ellipsis seen in the view of the lower block, and the indentation in the front of the section, show the situation and form of a groove cut in the wood, for the sake of lightness.

The cross sheave in the top block is contained in a shell of metal, through which the strap passes, and thereby retains it in its proper situation, or the cross sheave may be contained in a mortise cut across the other (either at right angles or diagonally) in the same piece of wood.

Fig. 1

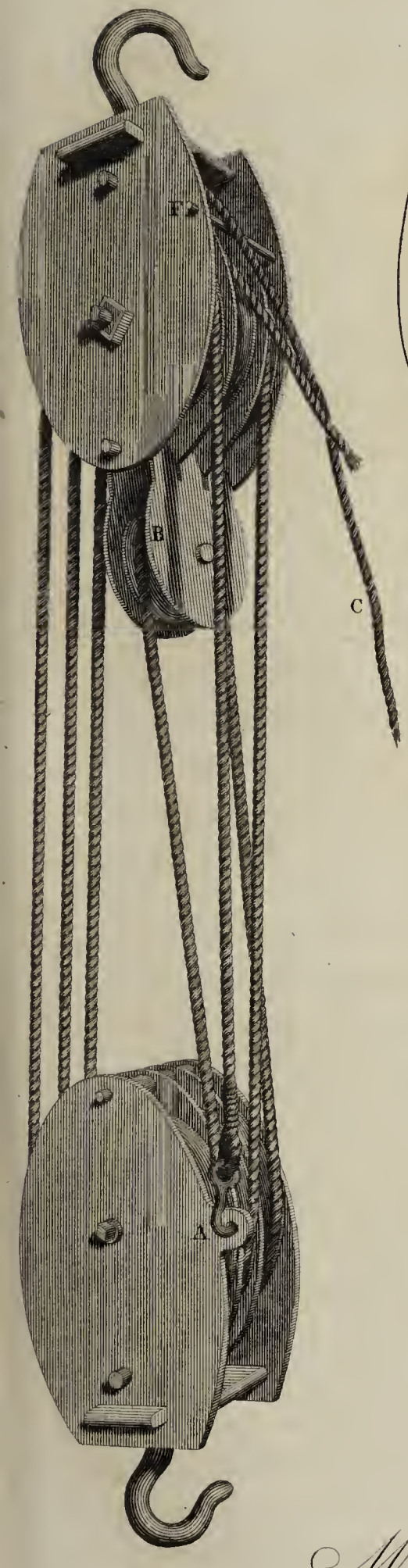



Fig. 2

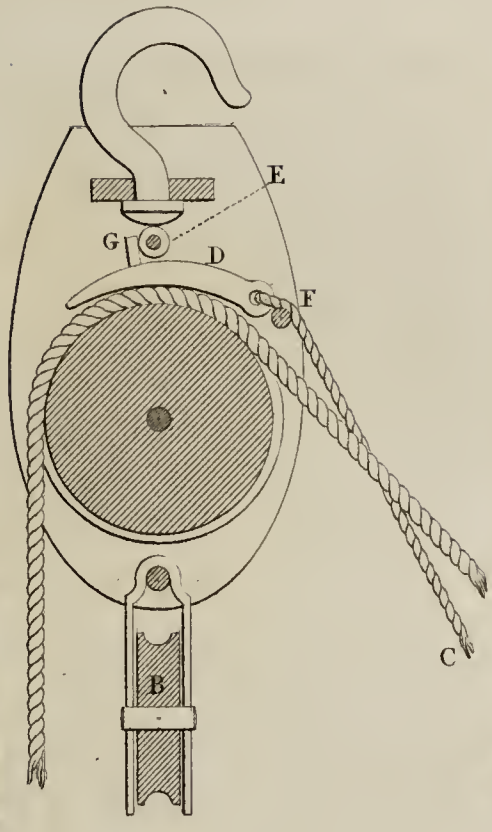



Fig. 3

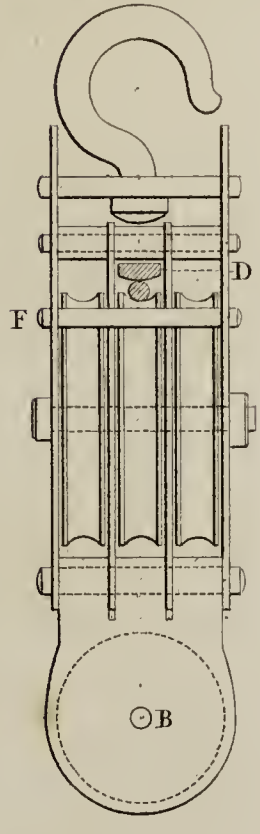
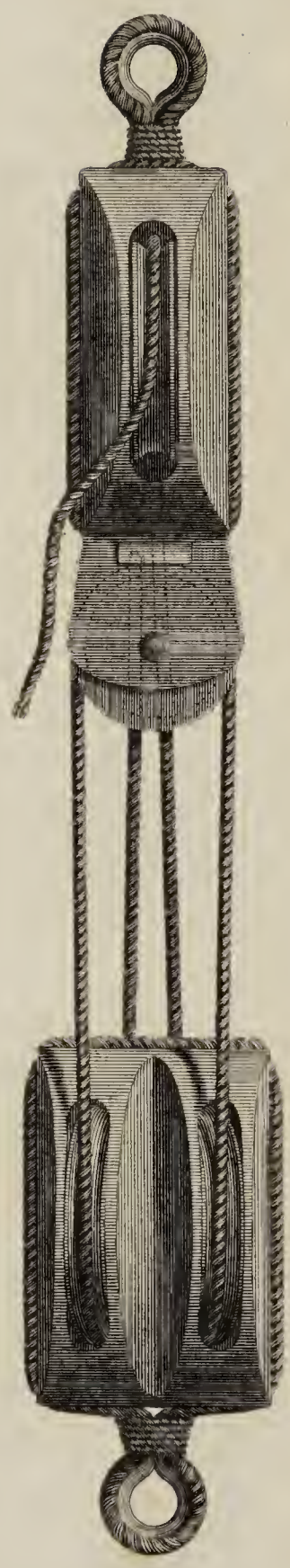
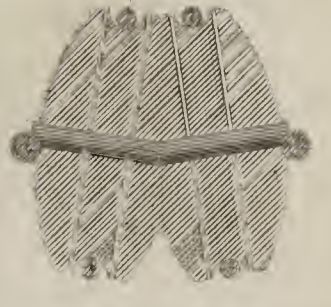



Fig. 4



Pl. 10.

Fig. 5



Mr. Ja.s Jonas's Blocks.

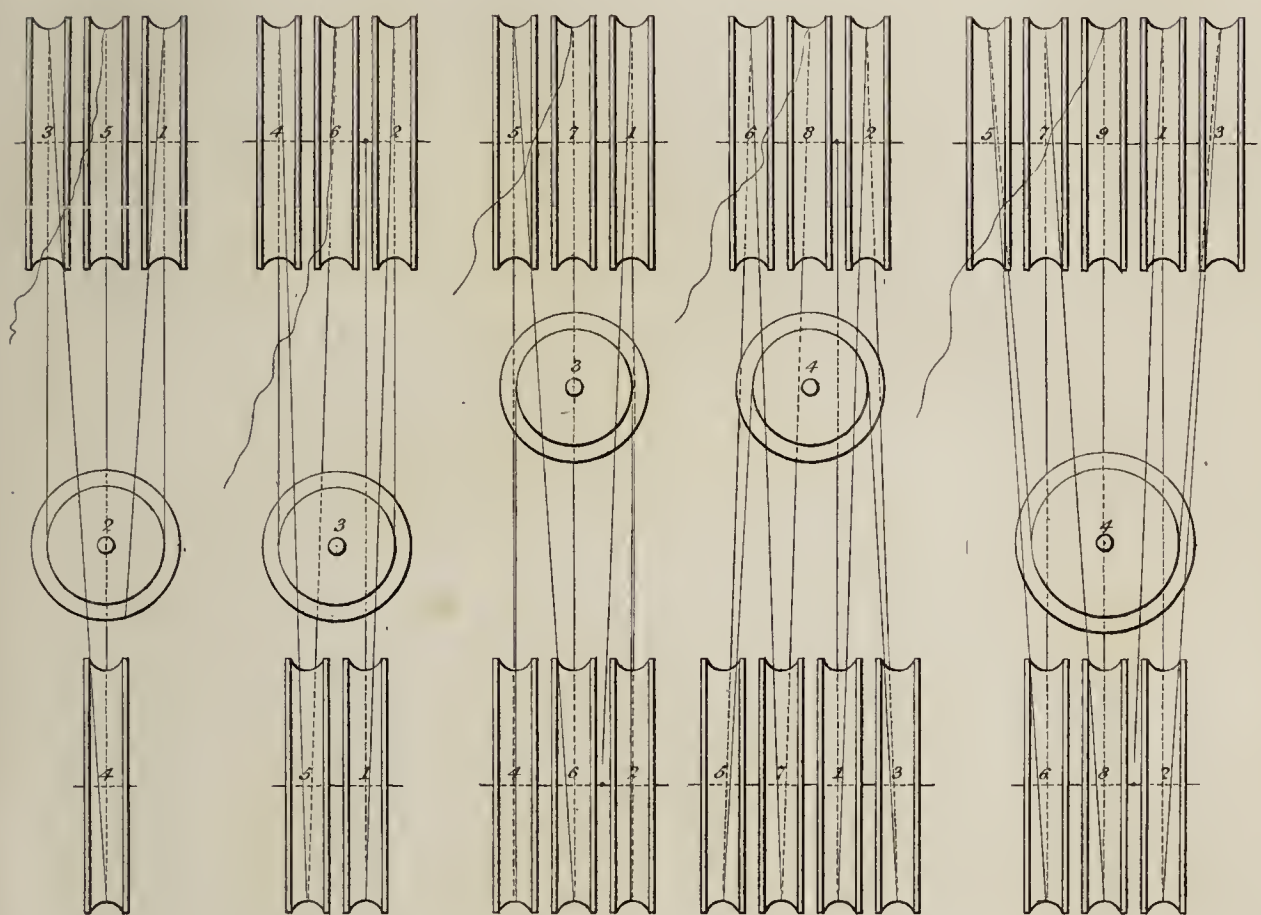
Drawn by H.R. Palmer.

Engraved by James Davis.

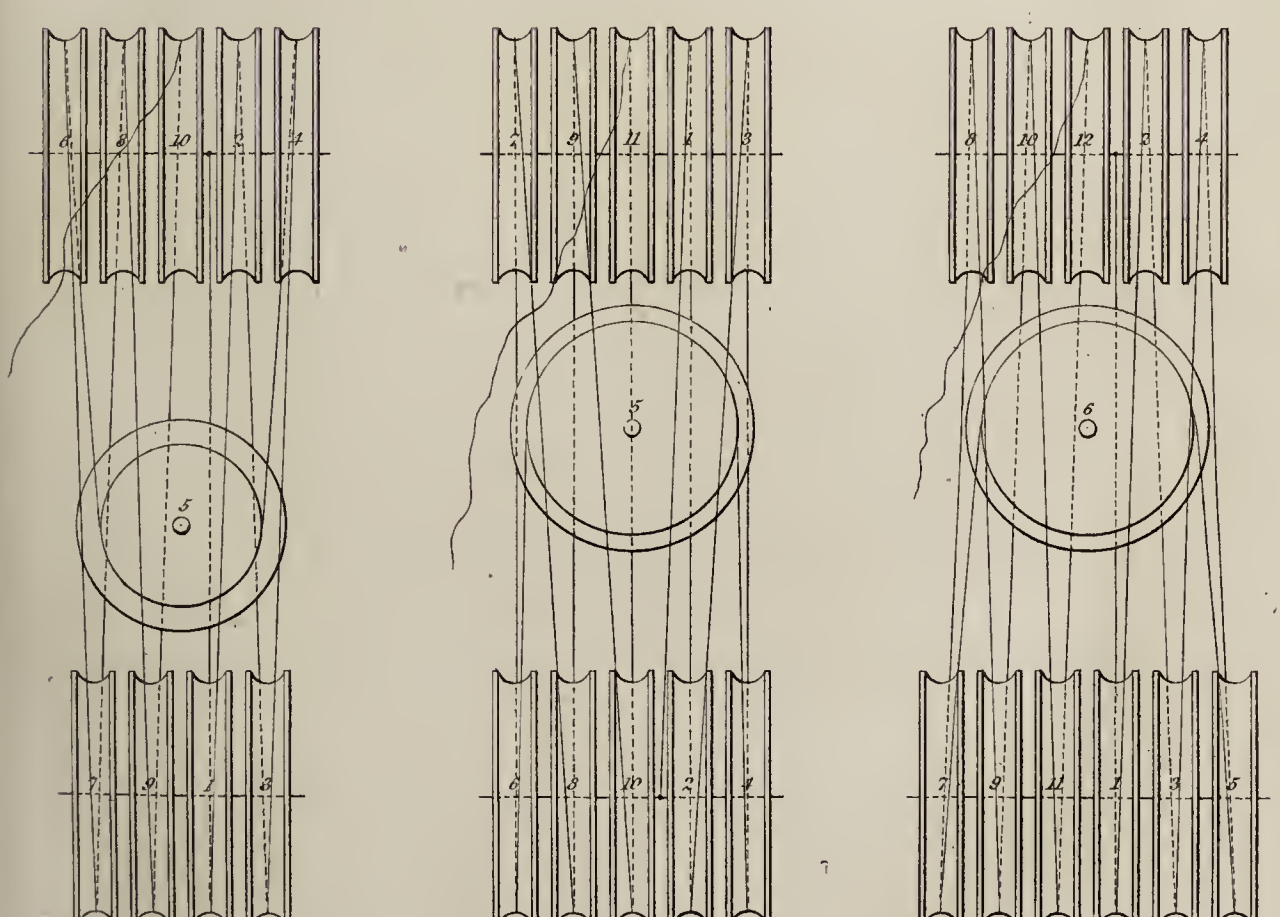
# Mr. Jones's Pulley Blocks.

Pl. II.

5 6 7 8 9



10 11 12



H.P.Palmer Delin.

J.Davis Sculp.

Plate XI is an outline of all the combinations from five sheaves to twelve inclusive; which several figures having every sheave numbered in its proper order, and the place of the tie designated by a black dot, are of themselves sufficiently explanatory.

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## N° XI.

## TURNING LATHE.

*The* SILVER MEDAL *was this Session presented to Mr.* T. LANE *of Stockwell, Surrey, for improvements in the* TURNING LATHE. *The following communication was received from the Candidate on the subject; and a Model of the Machine is preserved in the Repository of the Society.*

Stockwell,
Feb. 3, 1818.

SIR;

I REQUEST that you will communicate to the Society an improvement that I have recently made in the Turning-lathe. Having often occasion for one in my own business, and having experienced the imperfection of those on the usual construction, I have been led to make the following modifications, the utility of which have been amply confirmed by my own experience.

This improvement consists in making the line to run double, and in affording an easy way of regulating the pressure. Hence the line is always kept tight and ready for use, without the trouble and loss of time in tightening and slackening the line as is necessarily the case when it

runs single. The common line, unless it is strained very tight, is apt to slip on the mandril wheel, and from its tightness it causes much friction in the collar where the spindle is large, and hence runs heavy.

In my arrangement the line running double has more power on the mandril wheel without its being half so tight as ordinary, neither does it bear down on the mandril wheel, hence this latter runs remarkably light. There is indeed in my construction an additional wheel or pulley, but as it runs on two small points, it does not add materially to the friction.

I have had this in use for two years, and have every reason to be satisfied with its performance.

I am, Sir,

&c. &c. &c.

THOMAS LANE.

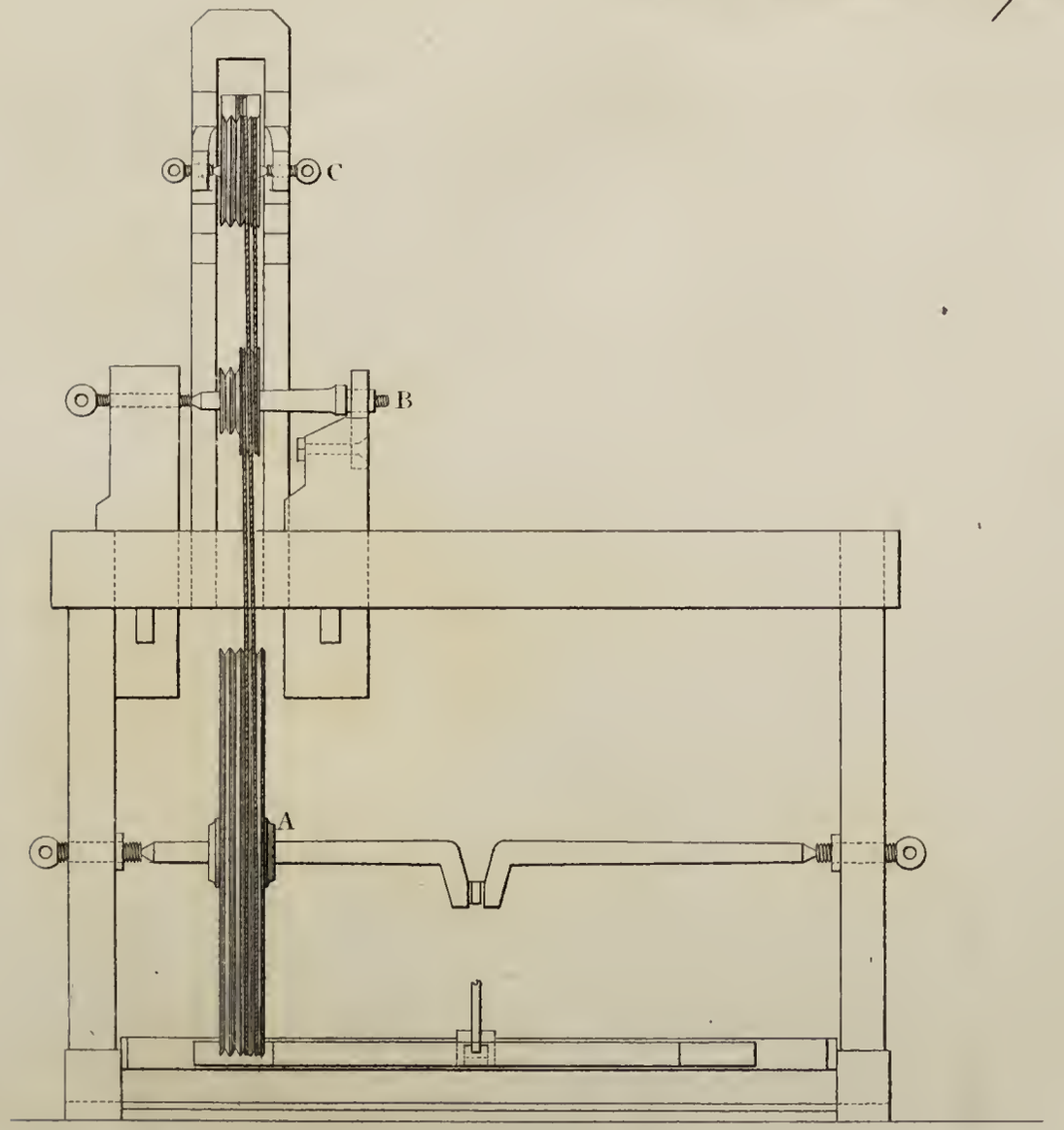
---

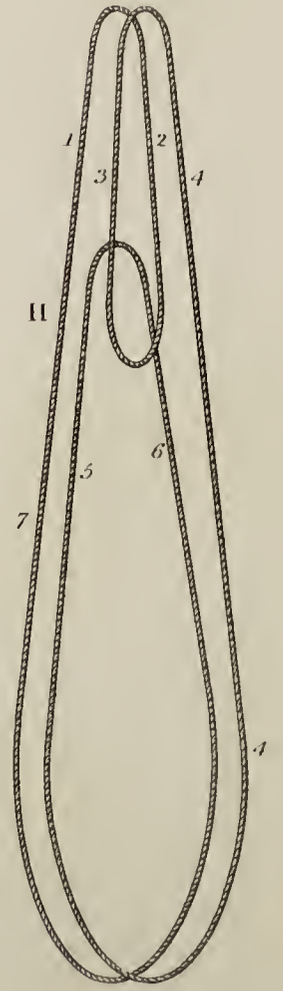
*Reference to the Figures of Mr.* LANE'S *Turning Lathe,— Plate XII.*

A, the fly wheel; B, the mandril wheel; C, the top wheel; D, a piece standing up with notches in it to form a rack: in this the cross piece, E, may be put to a proper height, so as to play up or down, according to the contracting or expanding of the band or line. F, the weight, the line of which runs over a small pulley G, pulling down the same, and raising the wheel C, thus keeping the band always tight.

To put the band on right, supposing one end to be at H going up at 1 over the left-hand groove of the top wheel, down at 2 under the right-hand groove of the mandril wheel B, up at 3 over the right-hand groove at C, down at 4 under the right-hand groove of the fly wheel A, up at 5

# Mr. Lane's Improved Turning Lathe.



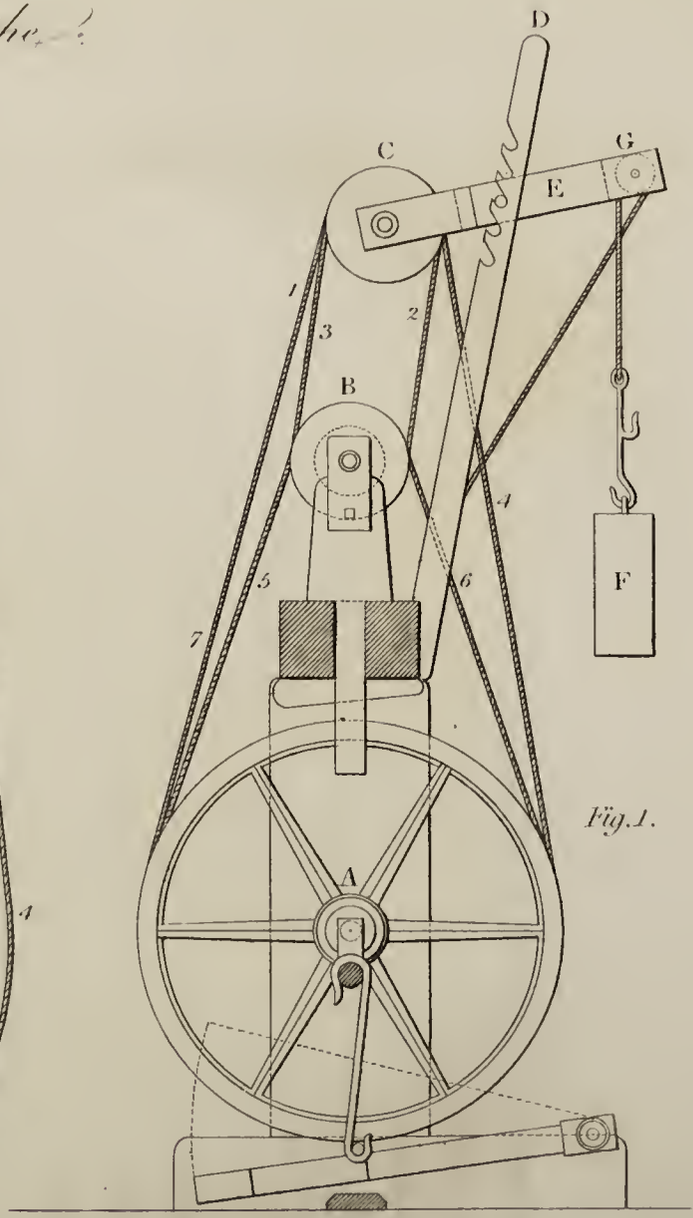




Fig. 1.

J. Clement del.

12 9 6 3 0 1 2 3 4 5 Feet

Jas. Davis, sculp.

over the left-hand groove at B, down at 6 under the right-hand groove of the wheel A, up at 7 meeting at H. The object of running the band in this way is, that it may have double power over the mandril wheel B, by going both over and under it; in the next place, the band being kept tight by the weight, it is always ready for use. There may be two or three different diameters of grooves in the mandril wheel, but it must be observed, that the two grooves which the band runs on at the same time on each wheel, must be exactly the same diameter one with the other, otherwise the band must slip and cause friction.

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## N° XII.

## IMPROVED DOOR LOCK.

*The sum of* FIVE GUINEAS *was this Session presented to Mr.* MOSES SOMERFORD *of Wolverhampton, for an* IMPROVED DOOR LOCK. *The following communication was received from him on the subject, and one of his Locks is preserved in the Society's Repository.*

Temple street, Wolverhampton,
Feb. 9, 1818.

SIR;

HAVING invented a new plan of working levers in Locks whereby they are rendered much more secure, and at a very little additional expense, I request that you will have the goodness to lay the same before the Society of Arts, &c. for their judgment.

It is well known that in the usual way of arranging the levers of locks, it is necessary that they should ascend to

their proper places before the bolt can pass; which arrangement gives an opportunity of introducing a nail, or a piece of stout wire, &c. into the lock, and thus raising the levers without the necessity of using the key. In the lock accompanying this letter, the arrangement has been changed, one lever being made to ascend, and the others to descend before the bolt can be shot. These works may be put into all kinds of locks without increasing their bulk, and the bolt may be made to take on one side of the lock or on the other. The lower ascending lever has an iron plate attached to it, the use of which, besides receiving the key and thus bringing it down to its central place, is, that it stands as a complete guard in front of the riding lever which descends. The lever on the top of the bolt is also of a new construction, having the lower levers working in its racks, and refusing to let them pass till it is brought to its proper position; on which account I have named it the master lever.

I am, Sir,

&c. &c. &c.

MOSES SOMERFORD.

*Reference to Mr.* SOMERFORD'S *Door Lock,—Plate XIII.*

Fig. 1, a front view of the lock, the upper plate being removed; *a a*, the bolt (shown separate in fig. 4) having a longitudinal perforation, in each side of which are four notches opposite each other; *b b*, a plate of brass fixed to the bolt by the pin and collet *c*, under which it freely moves (shown separate fig. 4); this plate has a perforation with four notches in the upper side, and three in the under, corresponding with the notches in the bolt, but deeper; *d d*, a spring fixed to the side of the bolt acting on the protuberance *b* of the plate *b b*, and pressing it on one side, so as to prevent the notched perforation corres-

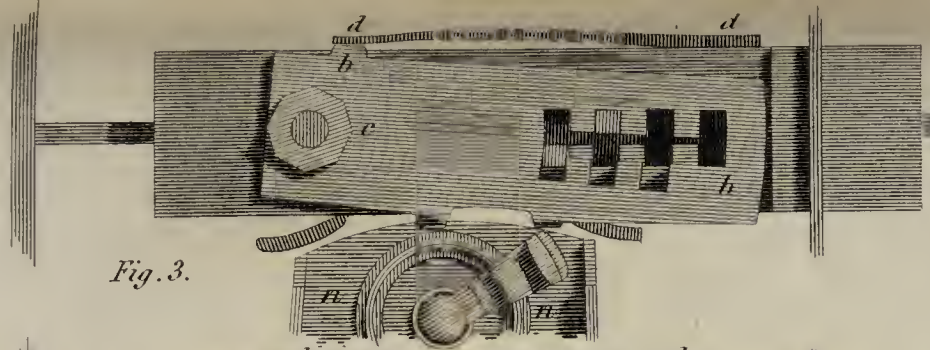



Fig. 3.

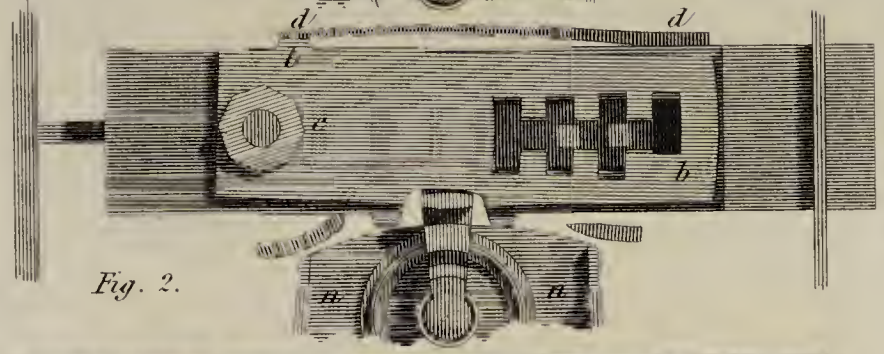



Fig. 2.

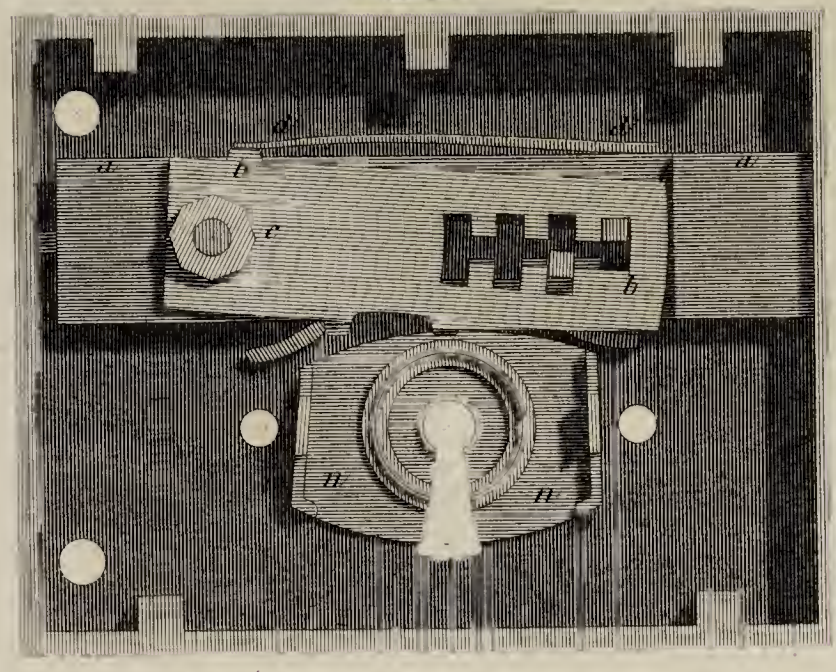



Fig. 1.

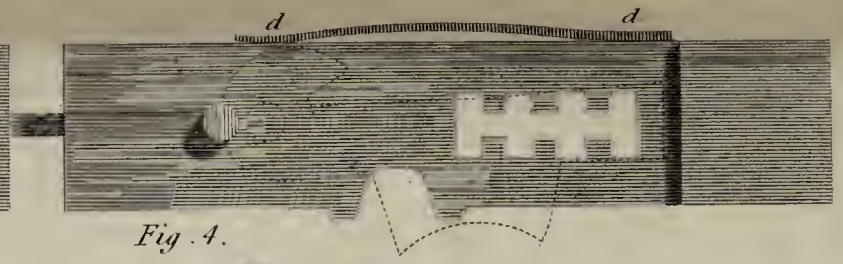
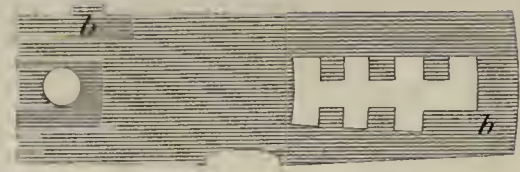



Fig. 4.



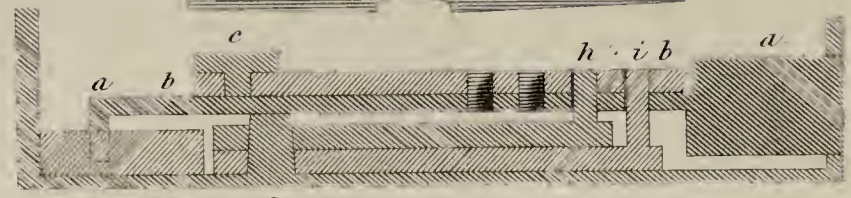




Fig. 6.

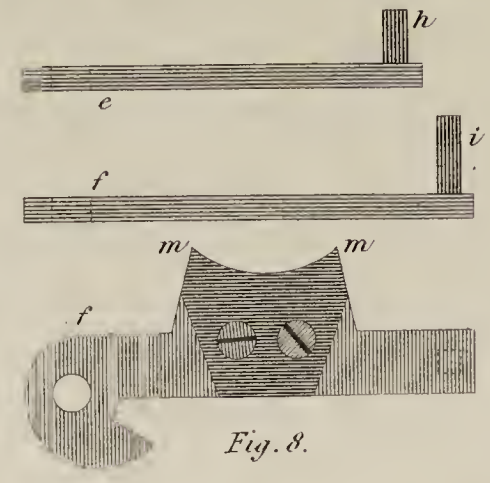



Fig. 8.

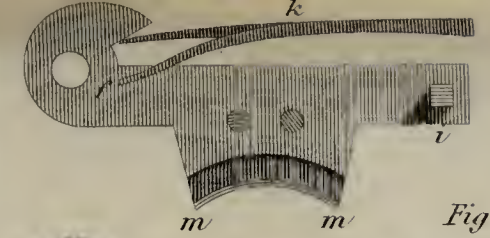



Fig. 5.

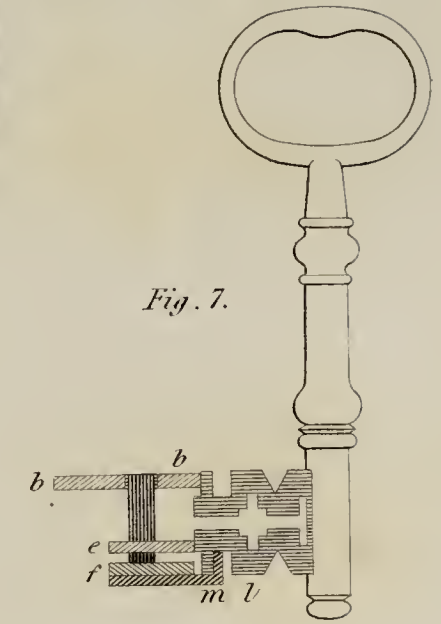



Fig. 7.

# Mr. Moses Somerford's Door Lock.

Cornelius Varley delt.

Edmund Turrell sculpt.

ponding with that in the bolt. Under the bolt are two more brass plates (shown separate fig. 5), the plate *e* lying on the plate *f*; their holes *e* and *f*, go on the same pin *g*, fig. 6 (their place under the bolt is shown in fig. 4 by dotted lines); these plates carry each a square iron pin, *h* and *i*, which rise up through the perforations of the bolt, and plate *b b*. One part of a double spring *k* (fig. 5) acting on the tail of the plate *f*, keeps the pin *i* in one of the upper notches of the bolt and brass plate, while the other part of the spring pressing on the edge of the plate *e*, keeps the pin *h* in one of the lower notches of the bolt; these pins lock the bolt, and keep it from moving either backwards or forwards. Therefore to move the bolt, the key must by its hook *l* (fig. 7), travelling in the groove *m m* of the under plate *f*, pull the pin *i*, just out of the upper notch, and no more, while the front of the key pushing the second plate *e*, moves its pin *h*, just out of the bottom notch, and no more, and now the pins *i* and *h* being even, the bolt is free of them, but is locked by its upper plate *b b*, catching them in two of its upper notches; therefore the upper front of the key must raise this plate to make its perforation coincide exactly with that in the bolt, and then it is free, as fig. 2, where the key is in its place, moving the bolt. Fig. 3, the bolt advanced, the key just left it, when one pin rises into the upper notch, and the other sinks into the lower notch of the bolt, and the plate *b b* falls with one of its notches on the upper pin, by which the bolt has three securities, and these are divided by the plate *n n*, which passes through the middle of the key, two securities below and one above, and these require such an accurate fitting of the key that no other is likely to open it.

Fig. 8, the under side of the brass plate *f*, the groove *m m*, is iron, and screwed to it.

## N° XIII.

## IMPROVED PENDULUM.

*The* GOLD ISIS MEDAL *and* THIRTY GUINEAS *were this Session voted to Mr.* D. RITCHIE, *of Clerkenwell, for an* IMPROVED METHOD OF GIVING MOTION TO A PENDULUM. *The following communications were received from him on the subject, and a Model of the Invention is preserved in the Society's Repository.*

Northampton-street, Clerkenwell,
SIR; Feb. 15, 1818.

THE application of the pendulum to a clock produced at once such an accurate mensuration of time as to render it conspicuous amongst the most important and useful of modern discoveries: and the *balance* which for ages had so imperfectly pre-occupied its place, is now almost consigned to oblivion.

Although the mode of communicating motion to the pendulum of a clock appears to be very complete, yet on a strict examination it will be found to have some defects and is still susceptible of a higher degree of perfection.

Whatever may be the nature of the scapement, that contrivance may be reckoned the best which transmits to the pendulum the impulse of the wheel, with the least loss of power; but in practice, the wheel and pallets and crutch pin and pendulum rod cannot act in the same, but in parallel planes. The pendulum will therefore rather receive an oblique impulse from the crutch by its bending at each stroke, and if made stiff and strong to prevent springing, whilst it promotes it absolutely opposes the motion of the pendulum, for since the crutch pin must pass through the slit in the pendulum rod with some

*shake*, which will be continually increasing by *wear*, and since it can only be in contact with one side of the rod at any moment of time, it will be alternately struck by either side of the crutch pin leaping from one side of the pendulum rod to the other; thus, during the ascent of the pendulum, the lower side of the rod is impelled by the ascending side of the crutch pin, but when the pallet drops from the wheel, the crutch pin will drop on the ascending side of the pendulum rod, checking its progress, and opposing by its weight the arch of vibration.

A great part of the motive force I conceive to be dissipated in this way, but by the introduction of a new principle, I shall entirely remove this double drop and weight, and bending of the crutch, and show how it is to be effected by means of the accompanying model, which I request may be submitted to the consideration of the Society of Arts.

In this model the crutch fixed to the axis of the verge, and the suspension of the pendulum are the same as usual, but in other respects there is an essential difference: it is however absolutely necessary that the spring on which the pendulum is suspended when included in the slit of the cock should be held fast by having their surfaces firmly united. This is never well done by a pin, but effectually by means of screws, which both press the surfaces together, and prevent separation. I shall further suppose that the bar which forms the pendulum rod has its front and back sides formed into parallel planes, so that when the axis of the verge is set truly level, and the pendulum suspended, those planes may cut the axis of the verge at right angles.

To the middle of the back of the pendulum rod, and at the distance of the crutch from the line of suspension, is fastened a flat piece of rectangular steel having a part at each end bent into planes at right angles to its surface;

these ends must be equidistant, and parallel to a plane passing through the axis of the verge and the axis of the pendulum, and therefore parallel to each other. In the ends of this piece are cut rectangular notches parallel to the pendulum rod into which a hardened and tempered watch chain is fixed, and this chain should be perfectly horizontal when the pendulum is at rest; it should also be just free of the front of the pendulum rod. The steel piece has cylindric grooves cut on the outside of each end, at either extremity of the chain, which are parallel to the axis of the verge: the extreme links must be made double the thickness of the chain, by having a link riveted on each side, and the steel piece should be hardened and tempered. To put the chain in its place, press the two ends of the steel piece to approach each other, which the springing of the material will admit, and insert the chain, so that the last double outside links are found to snap into the cylindric grooves; this will secure it, and the elasticity of the piece will keep the chain in a constant state of tension; thus the whole apparatus is fixed to the pendulum, and becomes a part of it.

In the end of the crutch is fixed a rectangular prism, having a rectangular groove in it, but both the external and internal sides, must be parallel to the axis of the verge. In this groove a piece of brass is made to slide backward and forward, and may be fastened in any position, by a finger screw on its lower side. The end of this piece next the pendulum rod, is at right angles to the horizontal sides of the groove, and forms a rectangle of 2 tenths by 5 tenths of an inch. This surface must be accurately parallel to the pendulum rod, or what is the same thing, perpendicular to the axis of the verge; a prismatic cover of the same dimensions is fitted to it by two steady pins. A finger-screw, whose head is on the back of the pendulum rod, passes freely through the cover, is

screwed into the end of the slider, and its shoulder bears against the cover; a hole is cut through the pendulum rod, to clear the screw and cover, and by this screw the two surfaces are brought in contact, and by unscrewing it, the cover is raised by the exertion of a spring, inserted between the two surfaces; between these the chain already described is to pass.

The spring on which the pendulum is suspended should be of steel hardened and tempered, not more than half an inch in length, and about the same breadth, pierced out in the middle, and that part of it which bends, need not exceed the tenth of an inch. The axis of the verge if produced should pass through the plane of the spring, and should be set truly horizontal, by placing a spirit level on the two ends of the arbour made cylindrical and of equal diameters; and when the pendulum with its chain passing between the sliding piece and cover is suspended, and at rest, the effect of gravity will give it a position at right angles to the horizon and to the axis of the verge, and will also necessarily determine the front and back sides of the rod, parallel to the frame plate.

Things being thus disposed, move the sliding piece until its end comes into contact with the chain, and by means of the finger-screw beneath the piece, fasten it in that position; and, lastly, the axis of the crutch being placed in the same plane as the axis of the pendulum rod, which its gravity will nearly effect, turn the finger screw at the back of the pendulum, and clip the chain fast between the end of the slider and its cover. By these means the pallets, crutch, and pendulum are locked together, and the whole braced by a kind of rectangular framing, of which the crutch and pendulum rod, and axis of the verge and sliding piece are the opposite sides, the whole vibrating together with one uniform uninterrupted motion; and this being the case, it seems more natural to

unite, rather than separate two bodies whose motion in all respects is the same.

The double drop can no longer exist, nor the springing of the crutch, nor its weight on the pivots of the verge, for it never becomes a part, and is supported by the pendulum, whose line of suspension is without friction. This line of suspension is but a continuation of the axis of the verge, or the same right line produced; and therefore any point taken either in the crutch or pendulum rod will describe concentric circles.

This is perfect in practice in respect of the verge with cylindric pivots, and true as to perception in the pendulum, although the arch of vibration were three times greater than usual. Thus my principle is, to lock the pendulum and crutch together, which may be done without an intermediate chain, by locking the pendulum rod to the end of the slider.

After long experience in things of this nature, and in this instance having determined by actual experiment that the same arc of vibration is maintained with less power than in the usual method, I feel a confident hope, that my principle will be generally adopted.

I am, Sir,

*A. Aikin, Esq.* &c. &c. &c.

*Secretary, &c. &c.* DAVID RITCHIE.

P. S. There are belonging to this model, a thin brass bar, to be placed in the rectangular slit through which the chain passes, and another which may be conceived to be the frame plate extended, with two spikes in it, whose points are parallel to the frame plate, and just touch the chain bar. The use of these are merely to examine whether or not the pendulum vibrates in the same plane, and that the plane of vibration is parallel to the frame plate, or perpendicular to the axis of the verge, which

must take place when the surface of the chain bar during the vibration of the pendulum is in constant contact with the two points.

---

*Reference to Mr.* David Ritchie's *Pendulum, Plate XIV.*

Fig. 1, a side view of the crutch cock and part of the pendulum bar; *a a*, the clock plate; *b*, part of the verge; *c*, the crutch; *d*, the pendulum bar having the part *e e* in the section as far as the dotted line *e e*, fig. 3; *f*, the slider and clip serving instead of the crutch pin; *g*, the slider screw; *h*, the clip screw; *i*, the grooved part of the crutch; *k*, the cover into which the screw *g* and steady pins of the slider fasten to fix it to the grooved piece of the crutch. Fig. 2, shows the part separated; *b*, the cover of the sliding clip; *m*, the spring which opens the cover when the screw *h* is loosened. Fig. 3, the back view of the pendulum bar; *n n*, the steel spring which extends the chain; *o*, the opening in the pendulum bar to make room for the slider clip and screw.

Fig. 4, a section of the pendulum bar above the spring *n*, showing a bird's eye view of the slider clip and spring *n*; *p p*, the chain extended by the spring *n n*, which the slider clip holds and attaches the crutch to the pendulum; *q q*, fig. 3, 13, and 5, the slits in the spring *n*, which receives the chain *p*; *r r*, fig. 5, the cylindric groove at the bottom of the slit into which the thickened ends of the chain *p* snaps, and is kept in its place.

Fig. 6, a front view of part of the pendulum bar showing the spring *n n*, chain *p p*, and the opening.

Fig. 7, a bird's eye view of a section of the clock plate *a a*, and pendulum bar *d*, showing a slip of brass which is laid in the slits *q q* of the spring *n n*, by the workman to know whether the pendulum vibrates parallel to the clock

plate, which is quite necessary; *t t*, two pins in another slip of brass *v v*, laid in notches *w w*; in the clock plate these pins nearly touch the slip *s s*, to show the error, if any, of the pendulum's vibrations.

The same effect may be produced by the following means, should they be preferred.

Fig. 8, *a*, represents a brass piece which is screwed to the pendulum rod, at a proper place, by two screws that pass through the screw holes *u* and *u*.

*x x*, represent two small steel cylinders which slide in cylindrical holes exactly in the same line as the two adjusting screws *y y*.

*z*, represents the end of the crutch pin held between the two cylinders *x x*, each of which is pressed firmly against the crutch pin by the screws *y y*.

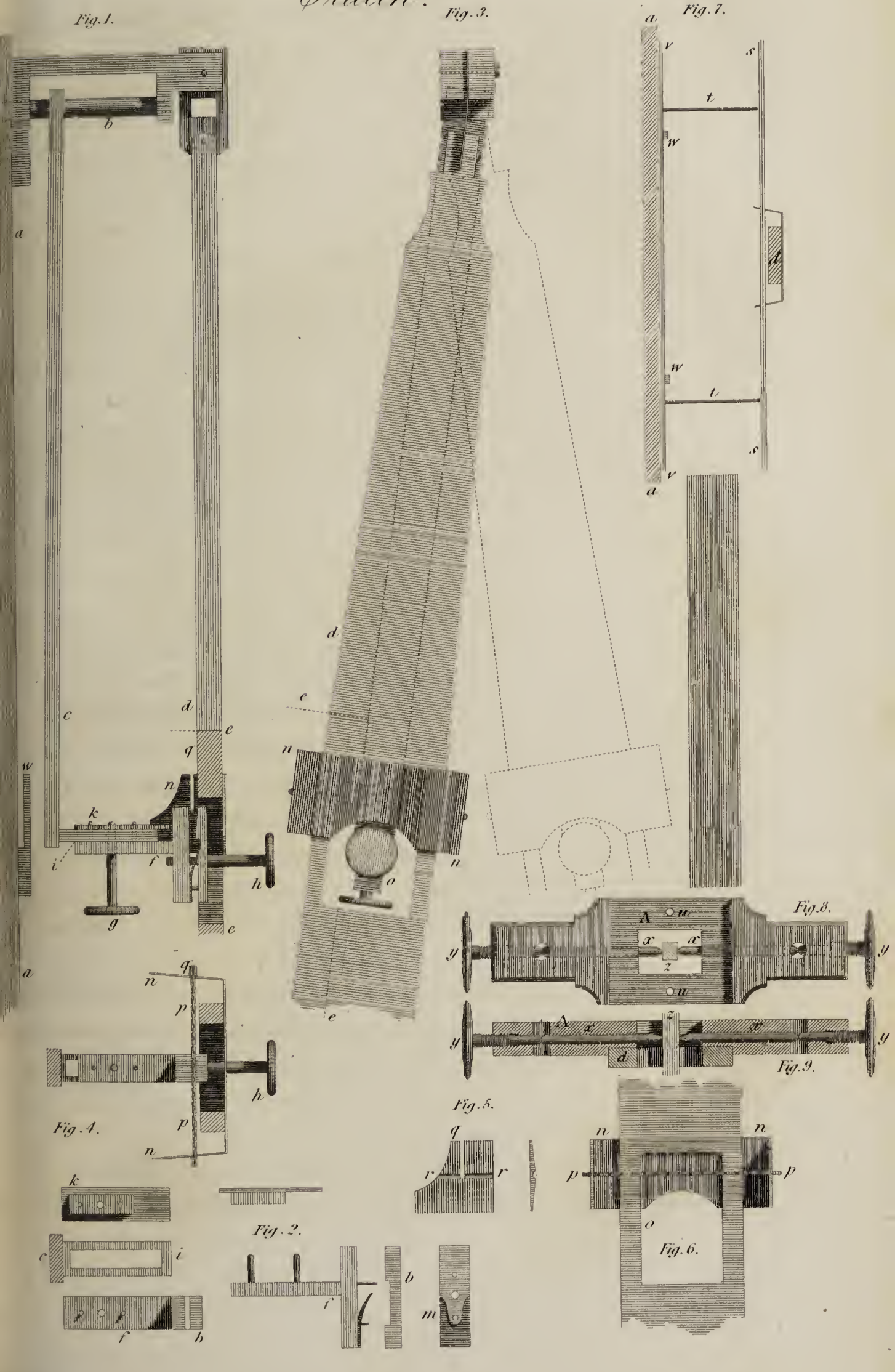
It must appear evident that the crutch pin may be shifted to the right or left as occasion may require, by slackening one of the adjusting screws and tightening the other. It may perhaps be thought superfluous to state that this is the adjustment for setting the clock in beat.

I shall here observe that the pendulum should be suffered to find its place of rest after the clock is fixed, that it may swing parallel to the clock plate, which it will do if the clock is fixed in a perpendicular position. The adjusting screws may then be applied to close the cylinders *x x* upon the crutch pin *z*, after which the clock may be brought into beat by using the adjusting screws as before described.

Fig. 9 represents the section of Fig. 8, by a plane passing through the screws *y y* of Fig. 8, the same letters being applied to the same parts.

# Mr. David Ritchie's Pendulum. Pl. 14.

## Crutch.




Varley del.

Edm.d Turrell sc.

## N° XIV.

## NIGHT LIFE BUOY.

*The* GOLD ISIS MEDAL *was this Session presented to Mr.* THOMAS COOK, *of Plymouth, for a* NIGHT LIFE BUOY. *The following communications were received from him on the subject, and a Model of the Invention is preserved in the Society's Repository.*

SIR;

I BEG leave to transmit through you to the Society for the Encouragement of Arts, Manufactures, and Commerce, the following account of the manner of fixing and using a Night Life-Preserving Buoy, a plan of which I had the honour of enclosing for the information and consideration of my Lords Commissioners of the Admiralty.

Captain Dacres, of his Majesty's ship Tiber, who (after the trial made by the admiral and four captains in the Harbour) had orders to try its efficacy at sea, and report thereon, wished and advised me to take this step, and (having previously written a letter to me stating his opinion, a copy of which I herewith enclose) handsomely offered to communicate any farther information respecting it, that the Society might require. Knowing from nearly eleven years experience how much something has been wanted to point out the situation of Life Buoys, when thrown to the assistance of men in the night, and also to the boats sent to their relief, which are seldom able to

find the spot even to recover the Life Buoys again, from various causes, I venture to hope that I have remedied this evil (through which many hundred lives have been lost) by the application of the composition of port-fire, as hereafter described. From among the numerous Life Buoys in use, I have selected, and with a little alteration adopted, one of the most simple, which we have the means of replacing, should that supplied be by any accident lost. This Buoy secured on two iron rods, and connected by a light chain to a spring; a piece of copper, on which the composition of port-fire is laced with wire, screwed into the perpendicular staff; and a common cannon lock, fixed in a piece of wood, placed by the head of the staff, with a copper tube, leading horizontally from the pan to the priming of the composition which contains a quick match quill tube, form the whole of the apparatus necessary for its use, so that in the event of a man falling overboard the laniard of the lock is pulled, the spring touched, and immediately a bright flame (not readily extinguished by the wash of a sea) is displayed, and points out a rendezvous for the man, and for the boat sent to his assistance.

I presume, Sir, the Society will be aware of the difficulty and improbability of finding a man in a dark night, when I state that a ship under a press of sail, when blowing fresh, frequently runs a quarter, sometimes half, and sometimes three quarters of a mile before she can round to, in order to lower a boat. But by the use of this Buoy (which on the alarm being given will be in the water a light in about five seconds, merely by pulling the laniard and touching the spring) the difficulty will be entirely removed, and the boat directed immediately to the spot.

If the plan, which is highly approved of at the India House, and by the Committee of Ship Owners, be generally adopted (and the trifling expense attending it, encourages me to hope this will be the case) seamen will

feel greater confidence in discharging such duties as necessarily expose them to the danger of falling overboard, and numbers will be restored to the service of their country, who otherwise would inevitably have had a watery grave.

I am, Sir,
&c. &c. &c.
THOMAS COOK, *Adm. Mid.*

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His Majesty's ship, Tiber,
SIR; Spithead, Jan. 11, 1818.

THE Life Buoy fitted by you on board this ship having been repeatedly tried, and the manner of fixing it, and the ease with which it is let go being so very simple and superior to any I have before seen, I have great pleasure in giving my testimony in recommendation of it.

I am, Sir,
*Mr. Cook,* &c. &c. &c.
*Midshipman,* JAMES R. DACRES,
*H. M. S. Rochfort.* *Capt. of H. M. S. Tiber.*

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The Tigris had one of the Life Buoys fitted on board by an order from the Admiralty as well as the Tiber, but was soon after paid off; the following is a copy of Capt. Henderson's letter:

His Majesty's Ship, Tigris, Portsmouth,
SIR; January 9, 1818.

HAVING had but little opportunity of trying your Life-Preserving Buoy, owing to its being so short a time on board, I do not consider myself competent to give a

decided opinion on it, but from what I have seen I think it is fitted on a most excellent plan, and does you great credit in turning your mind to so useful an invention.

I am, Sir,

*Mr. T. Cook,* &c. &c. &c.

*H. M. S. Rochfort.* R. HENDERSON, *Capt.*

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Rochfort, Portsmouth Harbour,

SIR; April 16, 1818.

HAVING been an eye-witness to several experiments made by way of trial on the great utility of your new-invented Night Life Buoy, and considering its high importance for the preservation of seamen's lives to surpass any thing of the kind extant, I cannot withhold the expression of my entire approbation of its worth, to the Navy; and only wish it was more in my power to advocate its necessity generally, for I think humanity should be always prompt in devising the best means for the safety of a fellow-creature.

I am, Sir,

&c. &c. &c.

WILLIAM RICHARDSON,

*First Lieut. of the Rochfort.*

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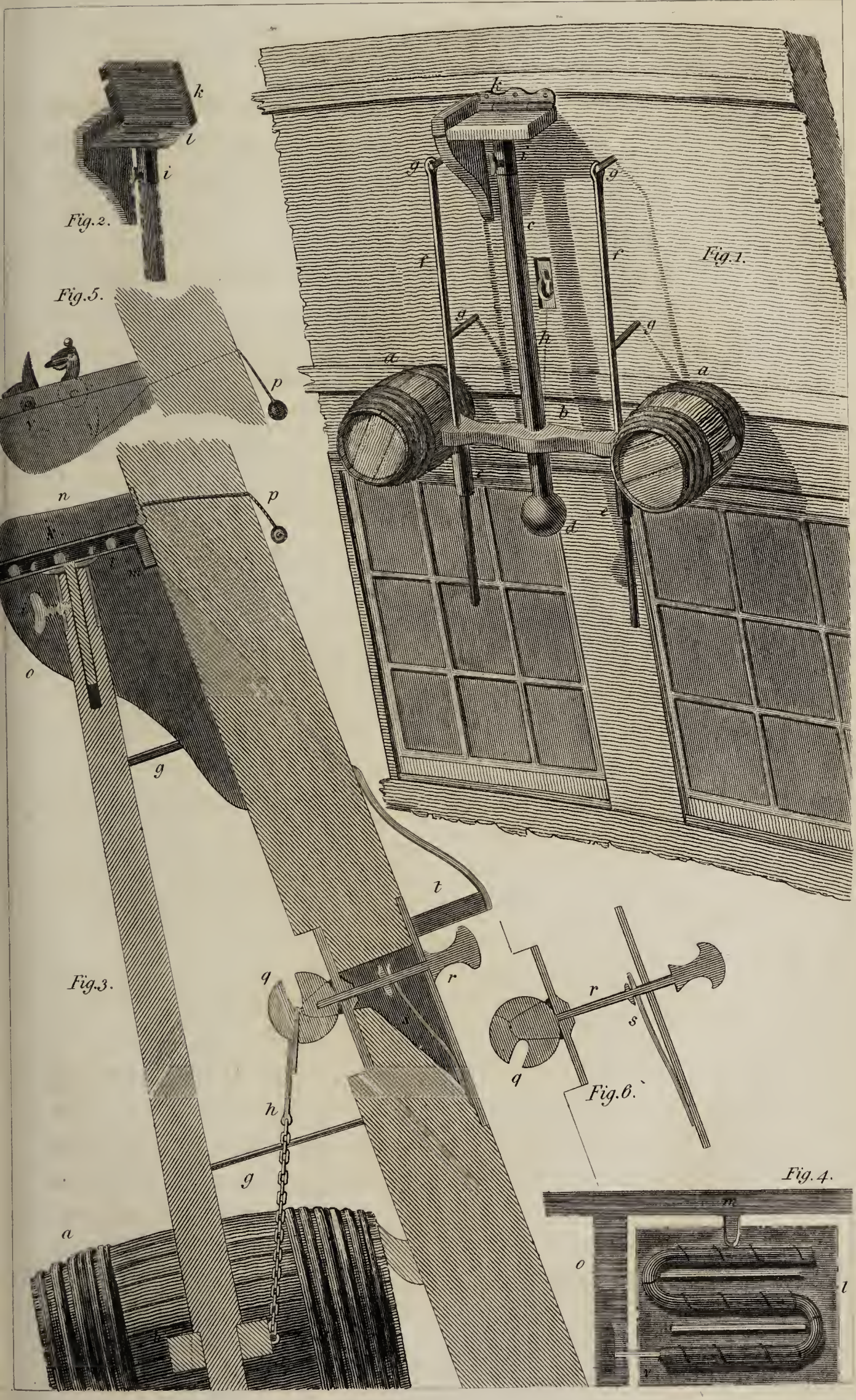
*Reference to Mr.* THOMAS COOK'S *Night Life Buoy, Plate XV.*

Fig. 1, a perspective view of the Life Buoy suspended over two middle windows of a frigate stern (that portion of the vessel only being shown); *a a* two casks connected by the bar *b*, passing through them; *c*, a staff, with a ballast weight *d* at the bottom, to keep it upright; *e e*, two wooden pipes firmly fixed to the bar *b*; these pipes slide on the two metal rods *f f*, which are fastened to the




Drawn by C. Varley.

Engraved by A.W. Warren.

stern at *g g g g;* a chain *h* suspends the Life Buoy, and with the rods *f f* keep it tight to the stern; a copper cap is hinged to the stern at *k;* this covers the copper table which carries the port-fire, and defends it from the weather: in fig. 2 the cap is lifted up to show the table *l;* a pin is fixed under it, which goes into the staff *x*, and is fastened by the screw *i:* in figs. 3 and 4, a piece projecting from the stern, and fitting a notch in the copper table to steady the Buoy at top; *n*, a copper cap on the bracket *o;* under this cap is the lock and tube *v*, shown figs. 4 and 5; *p*, a laniard to pull the trigger; *q*, a roller with a notch for the chain *h*, to hook in *r*, a bolt which goes in a hole in the roller, and is kept there by the spring *s;* after pulling the trigger to light the port-fire, this bolt is pulled, which unlocks the roller, which turns round as fig. 6, and lets go the chain *h;* the Life Buoy then drops off the rods *f f*, into the sea; *t*, a guard to prevent the bolt being loosened by any thing falling on it. Fig. 4, a bird's eye view of the copper tablet *l*, with the port-fire laced on with wire; *o*, the bracket which holds the lock; *v*, the tube conveying the fire from the lock to the port-fire.

## N° XV.

## NEW METHOD OF BALLASTING VESSELS.

*The* SILVER MEDAL *was voted this Session to Lieut.* MOLYNEUX SHULDHAM, *R. N. for a* NEW METHOD OF BALLASTING VESSELS. *The following communications were received from him on the subject, and Models of his Invention are kept in the Society's Repository.*

34, Gloucester Street, Queen Square,
March 31, 1818.

SIR;

A PLAN of my invention, for an Improvement in the Mode of Ballasting Small Vessels, in order to increase their sailing qualities, having been tried by order of the Lords Commissioners of the Admiralty, and the result of the trial proving successful, I am induced to request you will favour me by laying the plan before the Society for the Encouragement of the Arts and Sciences, in the hope that, should they deem its merits to be such as the experience I have had of it has led me to imagine, they will, by honouring me with some mark of their approbation, be the means of drawing thereto the attention of scientific men, which may cause it to be put to farther trial.

Models of my plan (which is very simple) accompanying this letter, it will not be necessary to trespass much on the Society's time with explanation. With regard to the principle, I will merely observe, that for ages back I believe it has been known to every school-boy, who has

amused himself with sailing little boats, that they sail infinitely better with their ballast fixed to their keels: the reason of which must be obvious to every mechanic; nevertheless, to ballast sea-going vessels in the same manner, by affixing to them leaden or iron false keels, has generally been thought unsafe, as the centre of gravity would be so low as to occasion them to labour much in a sea-way, an evil certainly very great. Now, in the application of such keels, properly modified, to sea-going vessels, without being attended with the danger above-mentioned, consists the novelty of my invention; for, by an easy and convenient method of raising or lowering a certain weight of internal ballast, the centre of gravity can be altered as judgment may direct, and adapted to any state of wind or sea;—thus, a vessel may, by a vast increase of stability, obtained by the centre of gravity being low, carry more sail than otherwise; which increase in the propelling power, would cause her to sail faster in proportion to its amount; the quantity of fluid she displaces being the same: this point, being so obvious, and having been practically proved, it will not be necessary, I conceive, to enlarge on.

I must observe, that the plan is chiefly intended for vessels whose principal quality ought to be that of fast sailing; such as dispatch vessels, government vessels to cruize after smugglers, post-office packets, &c.

The enclosed copy of a report respecting a boat, built under my inspection, at his Majesty's Dock-yard at Plymouth, will fully prove to the Society how well the plan, so far, practically answered. Its success induced the Lords Commissioners of the Admiralty to order it to be tried on the Quail cutter, to which vessel, however, it did not prove so decidedly beneficial, although her sailing qualities were thereby much improved; the reason of this arises from the form and dimensions of the Quail not

being in unison with the plan, which is more suitable to a narrow vessel, and of such construction, that, without the aid of the lever of a heavy false keel, she would not have sufficient stability: such was the construction of the boat (a model of which I now present to the Society), and, had the plan been tried in a vessel of proportional dimensions to her, I can venture thus publicly to declare my belief, although with the greatest deference, that she would have outsailed, in working to windward, every vessel of her dimensions and tonnage, ballasted in the usual way, on the seas; the flying prows of the Ladrone Islands, or some other inapplicable plans perhaps excepted.

There is a model of the Quail at Plymouth Dock-yard, on a scale of an inch to a foot, which would show a still better method I have of raising and lowering the ballast, combining the advantage of the ballast lowering itself, if required, and that in a few instants: should I be able to obtain that model, I shall feel great pleasure in presenting it to the Society.*

I beg leave to enclose, besides the above-mentioned copy of report, a certificate from captain Ekins, also letters which I have received from persons who have sailed in the boat built at Plymouth, as well as from those who, from the complete success of the plan in that case, were induced to try it on their own boats.

Trusting the Society will pardon this intrusion on their valuable time,

I am, Sir,

*A. Aikin, Esq.* &c. &c. &c.

*Secretary, &c. &c.* MOLYNEUX SHULDHAM.

* This model is now in the Society's Repository.

(Copy.)

Plymouth Yard,
April 21, 1817.

SIR;

Sufficient trial having been now made of the boat built in this Yard under the superintendence of Lieutenant Shuldham, to ascertain her qualities in comparison with the fastest sailing boats which we could get to put in competition with her; we beg leave to acquaint you, agreeably to your minutes of the 11th February last, that two of our most eligible boats for the purpose having been tried against the said boat, the latter (Lieutenant Shuldham's) has been found much superior thereto in sailing, particularly in turning to windward against a lee-tide.

The transom of Lieutenant Shuldham's boat being raised considerably higher than those of boats in general, her body is enabled thereby to be brought down in the water for sailing without dipping the same. Boats, as commonly built, when brought down, feel an inconvenience in proportion as the transom drags in the water; and how far the boat in question, or indeed any vessel with her transom raised so high, would answer *in a sea*, and in case of getting *sternway in stays*, we cannot speak to, not having seen the boat in such a situation (the water being smooth); but we should think there would be danger in the event of the boat getting sternway, from the transom being so high, and she so lean abaft.

We observed that this boat never lost her way in stays, and being decked flush with the gunwale, and having an iron keel of considerable weight brought to her deep wooden keel, so powerful a lever is created thereby, and by the internal weight of ballast, &c. as to enable her to carry a greater proportion of sail than any other boat of similar tonnage can possibly do; nor, if the well-supported

masts stand, is there the smallest danger of her upsetting, even when having some streaks of the deck in the water.

The following is the weight of the boat, &c.:

| | *tons.* | *cwts.* | *qrs.* | *lbs.* |
|---|---|---|---|---|
| Boat alone . . . . . | 2 | 2 | 0 | 12 |
| Iron-keel, bolts, &c. . . . . | 1 | 3 | 1 | 9 |
| Iron ballast . . . . . | 1 | 16 | 0 | 6 |
| Lead Do. . . . . | 0 | 14 | 0 | 14 |
| Men, sails, rigging, stores, &c. . . . | 1 | 2 | 0 | 12 |
| Total . . . . | 6 | 17 | 2 | 25 |

length in the extreme 32 feet, and 30 in keel; and extreme breadth 8 feet: tonnage, by measurement, $10\frac{84}{94}$ tons.

The plan of raising the ballast to the centre of gravity when going large, to prevent the boat from rolling, we noticed to have the desired effect, for after bearing up, when round the east end of the island, she rolled pretty quick and deep, until the ballast was raised, after which she proceeded as steadily as boats of her tonnage are accustomed to do in sailing.

But notwithstanding the great superiority this boat had over the two which were tried with her, as well as over many others which we have witnessed sailing against her, we shall submit, in order to establish a judgment in respect to the plan on which she is fitted being calculated to answer general purposes, that one of the best sailing revenue cruizers be fitted for trial against another of as nearly similar tonnage as possible, and, if possible, still better sailing qualities, although the boat in question has answered beyond expectation.

Underneath is a statement of the particulars of the sails used in the principal yard boat, and in that of Lieutenant

Shuldham's at the time of trial. Herewith you will be pleased to receive a drawing of the said boat, describing her internal fitments.

We are, Sir,

&c. &c. &c.

J. JACKSON,
W. BROWN,
A. CHURCHILL.

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*Lieutenant Shuldham's Boat.*

| | | | | | |
|---|---|---|---|---|---|
| Large Jib . . | $7\frac{1}{4}$ | $7\frac{1}{4}$ | $5\frac{1}{4}$, $7$ | 23 | yards of canvas. |
| Foresail . . | 7 | $8\frac{1}{3}$ | $8$, $6$ | $54\frac{1}{4}$ | Do. |
| Gaff Topsail . | $7\frac{1}{4}$ | | $4\frac{1}{2}$, $5\frac{7}{8}$ | $19\frac{1}{4}$ | Do. |
| Mainsail . . | $6\frac{1}{2}$ | $8\frac{3}{4}$ | $7\frac{3}{4}$, $6$ | $52\frac{1}{2}$ | Do. |
| Gaff Topsail . | 7 | | $4\frac{1}{2}$, $5\frac{5}{6}$ | 19 | Do. |
| Mizen . . . | $4\frac{1}{4}$ | 5 | $4\frac{1}{6}$, $3\frac{1}{4}$ | 14 | Do. |
| | | | Total . . . | 182 | |

*Twelve-Oared Yard Cutter.*

| | | |
|---|---|---|
| Jib . . . . . | | $24\frac{3}{4}$ |
| Foresail . . . . . | | $30\frac{1}{2}$ |
| Mainsail } Spreet . . . . . | | 40 |
| Mizen } Spreet . . . . . | | $13\frac{1}{4}$ |
| Total . . . . | | $108\frac{1}{4}$ |

*Reference to the Engraving of Lieutenant* SHULDHAM'S *Method of Ballasting Vessels, Plate XVI.*

Fig. 1, an elevation of the Quail cutter, part of the side being taken out to show the disposition of the moveable ballast.

Fig. 2, a plan of Do.

3, a section of Do.

4, a projection of Do.

*a*, the fixed ballast of lead or cast iron, forming part of the false keel.

*b*, the moveable ballast, arranged in a box or frame traversing on a screw, and thus admitting of being raised or lowered at pleasure.

*c*, a screw, the threads of which form a close spiral and therefore capable of being managed by the capstan bars *d*.

*e*, a screw, the threads of which form a loose spiral, and therefore admits of much more rapid motion than the former, but requires for its due government the addition of a cog-wheel *f*, and pinions *g g*, together with the winch *h*.

Figs. 5, 6, 7, are a section, elevation, and plan, representing one method of adapting the fixed ballast *a* to the keel, by a sliding dove-tail, parallel to the keel *k*.

Figs. 8, 9 are a plan and elevation representing the method of fixing the ballast *a* to the keel *k*, by alternate transverse dove-tails.

Figs. 10, 11 are a plan and elevation of a mode of connecting the pieces of the fixed ballast *a* together, below the keel, to which they are afterwards fixed by vertical bolts.

Figs. 12, 13, 14, 15, plans and sections of two different forms of ballast-boxes.

# Lieut: Shuldham's method of ballasting Vessels.

Pl. 16.

Fig. 3.

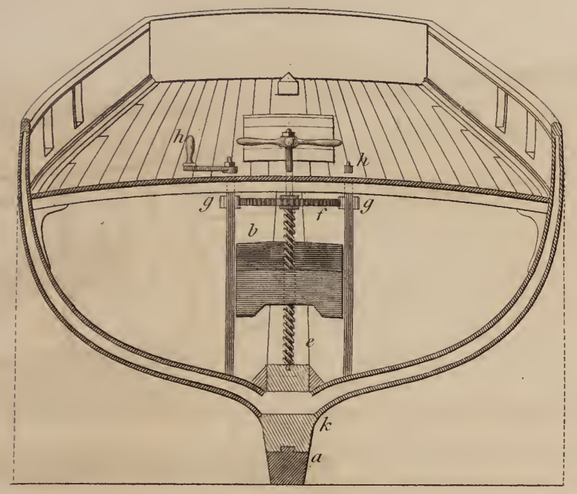



Fig. 1.

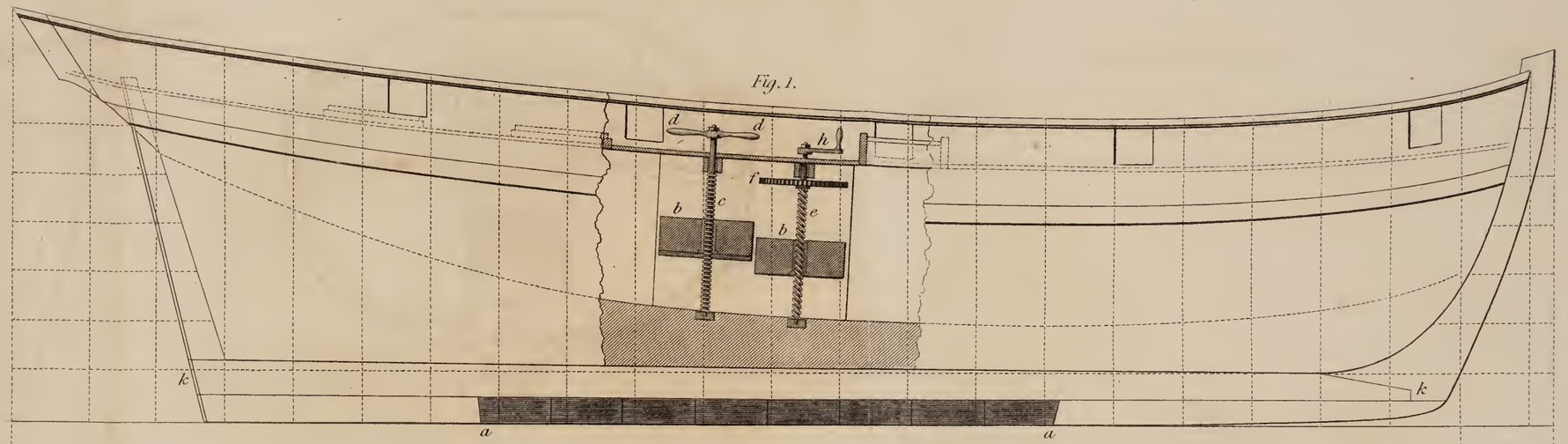



Fig. 2.

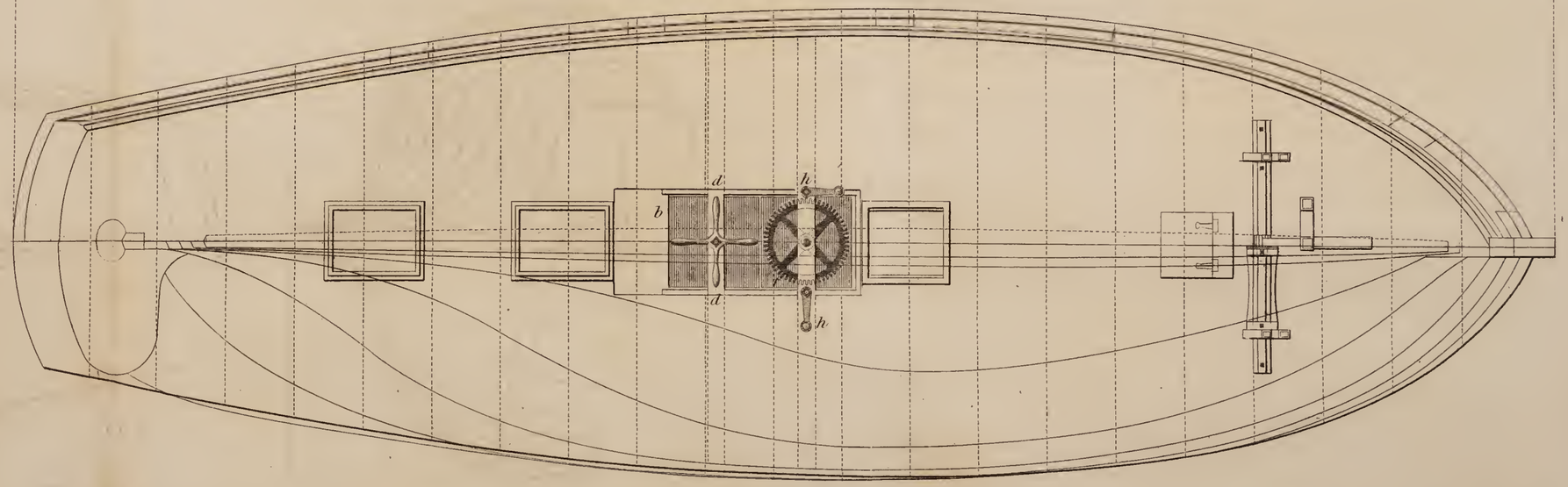



Fig. 4.

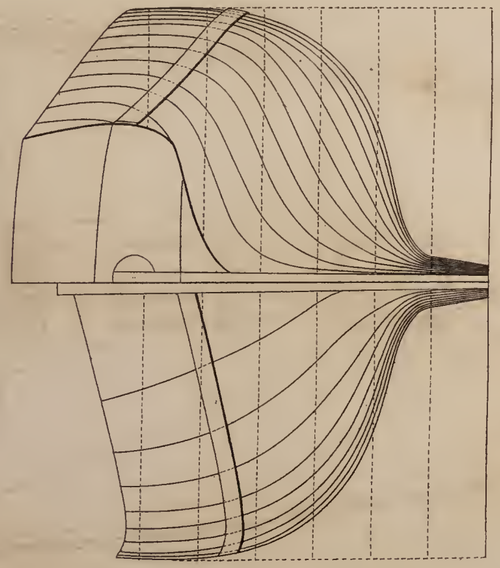


Fig. 5.

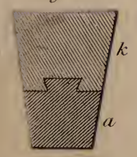



Fig. 6.

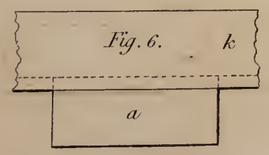



Fig. 7.

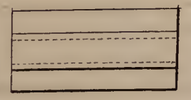


Fig. 8.

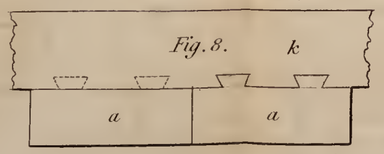



Fig. 9.

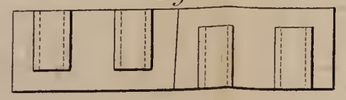


Fig. 10.

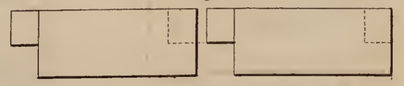


Fig. 11.

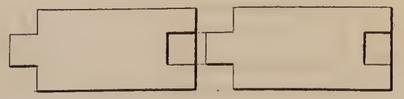


Fig. 13.

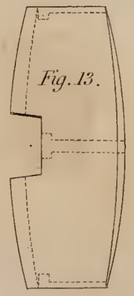


Fig. 12.

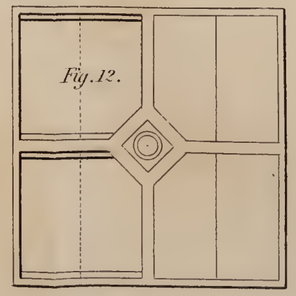


Fig. 15.

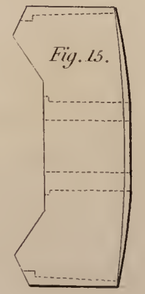
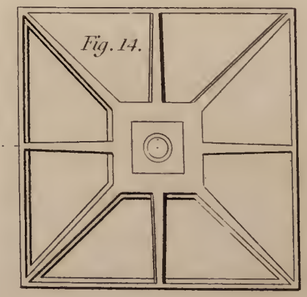


Fig. 14.



Drawn by Joseph Clement.

Engraved by James Davis.

## N° XVI.

## INSTRUMENT FOR DESCRIBING ELLIPSES.

*The* GOLD MEDAL *of the Society was this Session presented to Mr.* JOSEPH CLEMENT, *for his* INSTRUMENT FOR DESCRIBING ELLIPSES, *&c. The following communications have been received from him on the subject, and a Copy of the Instrument has been ordered by the Society for the purpose of being added to the collection of Models and Instruments already in their Repository.*

No. 12, Prospect Place, St. George's Fields,
SIR; January 6, 1818.

I BEG leave, through your means, to lay before the Society of Arts, &c. an instrument of my invention, for describing Ellipses, &c. which I find exceedingly convenient in my business of a mechanical draughtsman; and thinking it might also prove beneficial to the public at large, I shall be happy in being afforded an opportunity of submitting it to the opinion of a committee of this Society (of which I have the honour to be a member), and I will attend with the instrument to explain its properties, whenever the Society may please to appoint.

I am, Sir,

*A. Aikin, Esq.* &c. &c. &c.
*Secretary, &c.* JOSEPH CLEMENT.

The following satisfactory testimony, from a very competent judge, of the high merit of Mr. Clement's instrument is subjoined.

No. 57, Great Titchfield Street,
DEAR SIR; Jan. 12, 1818.

I HAVE great pleasure in giving my testimony to the superiority of your Elliptical Machine: there is no one that I have seen that is so convenient in its application, or so comprehensive in its powers; and as a proof that I think so, I shall be glad to have one for my own use, notwithstanding the one of my own contrivance is universally allowed to be very perfect. Wishing you success with it,

I am, Sir,
&c. &c. &c.
W. LOWRY.

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*References to the Engravings of Mr.* JOSEPH CLEMENT'S *Instrument for drawing Circles, Ellipses, Parallel, Radiating, and Spiral lines; the Teeth of Wheels, and the Threads of Screws; and for dividing Right Lines, Circles, and Ellipses, both geometrically and perspectively.*

This instrument is capable of describing ellipses, &c. of any possible dimensions or proportions of diameter, and in any direction or situation within the size of the instrument, as will be clearly shown by the specimens of its performance in the accompanying plates.

Plate XVII is a perspective view of the instrument without its upper dividing plate. The same letters of reference refer to the same parts of the instrument in this as well as in the succeeding plates.

Plate XVIII, fiig. 1, is a plan of the Instrument, also without the upper plate, for dividing ellipses, having a winch or handle fixed instead thereof to turn it by.

Fig. 2 is a section of the instrument, with the radial bars parallel to the lower sliding bar.

Fig. 3, a plan or bird's eye view of the instrument, with the dividing plate and index, for dividing ellipses, geometrically and perspectively.

Fig. 4 represents a front elevation of fig. 3.

Plate XIX is an elevation and section of those parts of the instrument, drawn to their full size, which could not be clearly shown on a smaller scale.

A A, is a square frame of brass, in which are fixed four pillars B B B B, having triangular holes at their upper ends, through which the two triangular bars C C, slide at right angles to each other.

In the centre of each of the bars C C is a conical hole, through the uppermost of which passes an axis, formed at one end, and on the upper side of the radial bar D, and at right angles to it (seen in the section at fig. 3, plate XIX); this axis is made a little conical, and passes through the hole in the sliding bar C, through the eye of the winch E, and is secured therein by the screw F, which adjusts the action of the joint, and by the binding screw G, which fixes it in any required position; H, a connecting piece, having a triangular hole and groove in it, through which the radial bar D, slides; and a female screw, in which the micrometer screw I, works, so as to move backwards and forwards, and retain it at any required situation; the upper part of the piece H, has a cylindrical cavity made through it, in which a cylinder fits, having a female screw in it, through which the micrometer screw I, passes, and underneath which a piece of woollen cloth is placed, lying upon the upper side of the radial bar D; this cylinder is pressed down upon the screw I, and upon the radial

bar D, by an adjusting screw J, acting in another female screw made in the upper part of the cylindrical cavity, so as to prevent any loss of time or of motion in turning the screw, and likewise to keep the radial bar steady in the angular cavity of the piece H. On the other end of the radial bar D, is fixed a piece K, having a cylindrical hole and cavity in it, to receive an axis with a shoulder on the end of the micrometer screw I, which has a pivot at its opposite end, working in a hole in the radial bar D, and a milled micrometer head L, fixed upon a short cylinder, with a steady pin or key to prevent its turning round, and secured and adjusted by means of a female nut screwed upon the end of it, which is received into a cavity made in the micrometer head L, for that purpose.

On the lower side of the connecting piece H, is a conical axis, at right angles to the radial bar D, passing through the hole in the centre of the lower sliding bar C, and into a conical hole made in the upper part of the lower connecting piece M, the lower side of which has a recess made in it, to receive a collet or washer, and which is prevented from turning round, by means of a steady pin or key; the end of the axis has also a female screw, into which a screw O, is received, which passes through, and presses upon the washer, and adjusts the proper tightness of the joint.

The lower connecting piece M, can be turned into any position upon the axis H, of the upper connecting piece, and be retained therein, by the screw O. On the under side of the lower connecting piece M, is another triangular hole and groove similar to that in the upper connecting piece H, through which the triangular bar P P slides, and furnished with a micrometer screw and milled head N, and with similar means of adjusting it as before described. On the end of the bar P P, is a piece Q, projecting downwards, having a dove-tailed groove in it, to

receive the dove-tailed slide of the socket R, which holds the drawing pen, pencil, or diamond point S for etching upon copper; this slide is furnished with two balls or weights T T, to press upon the pen, &c. On the back part of the piece Q, is fixed a spring U, the end of which is bent nearly at right-angles, and passes through a hole into the dove-tailed groove. At the back-part of the dove-tailed slide R, fig. 4, plate XIX, is a recess to receive the end of the spring U, which does not then press upon it, but permits the weights T T to act; if however the pen, &c. be raised up, it then presses upon the flat or solid part of the slide below the said recess, and prevents the pen, &c. from falling down. The cylindrical stem of the drawing pen, &c. S, is furnished with a web, which fits into a slit in the socket, to keep it steady, and prevent it from turning therein. Fig. 5, plate XIX, is a view of the upper side of the radial bar P, showing the dove-tailed groove, in which is the slide of the socket R, for holding the drawing pen, &c. Fig. 6 is a front view of the slide and socket; and fig. 7 the socket, in which can be placed a pencil or diamond point. The two micrometer screws I, and X, are made four threaded, so as to cause the radial bars D D, and P P, to move with greater velocity than can be done with single threaded screws; one turn of the screw moves the radial bar forwards one-tenth part of an inch, and the micrometer heads being also divided into ten equal parts, every division thereof is equal to the one-hundredth part of an inch; and these divisions can easily be subdivided into ten parts each, where greater accuracy is required, thus adjusting the radial bars to the one-thousandth part of an inch. Having thus described these several parts, I shall next proceed to mention the manner in which they are applied to use. When the axis at the end of the upper radial bar D D, is brought into a line with the axis of the connecting piece H, that side of the

said connecting piece, which is towards the micrometer head, will be at zero, on the scale of divisions on the radial bar D D; and the micrometer head will also stand at the zero of its scale. If the zero of the divisions on the lower radial bar P P, be then brought into contact with the same side of the lower connecting piece M, and its micrometer head also placed at zero, the drawing pen, pencil, or diamond point, will be in a line with the axis of the connecting piece H, and if the handle or winch E, be turned round, it will describe or form a point only. If the micrometer head on the screw of the lower radial bar P P, be then turned, until the two hundredth division on the radial bar is brought into contact with the side of the connecting piece M, and the handle be turned round, the pen &c. will describe a circle of four inches in diameter; or it may be made to describe any other circles, within the limits of the instrument. If, however, the micrometer head of the screw on the upper radial bar D D, be turned, until the one-hundredth division of the scale upon that bar be brought also into contact with the side of the connecting piece H, and the handle be turned round, the pen, &c. will describe an ellipsis, the longest or transverse diameter of which is four inches, and its shorter or conjugate diameter two inches, as shown at *a*, in fig. 1, plate XVIII. — All the varieties of ellipses, from a circle of four inches diameter, to a straight line, may be described by turning the micrometer head of the screw of the upper radial bar D D only, without altering that of the lower one. And whenever the sides of the connecting pieces H, and M, are brought into contact with similar divisions on the radial bars, a straight line will be drawn, on turning the handle of the instrument round.

If the lower radial bar P P, alone be successively moved within the connecting piece M, it will describe

lines parallel to any given circles or ellipses within the extent of the instrument.

The instrument having been adjusted as above described, to draw the ellipsis *a*, in fig. 1, plate XVIII, which forms one end of a short cylinder, in order to draw the sides *b b* the square frame A A is mounted upon another frame V V, and can be moved along a dove-tailed groove in the latter, by turning the milled head *v*, on the axis of a pinion, which acts in a rack, formed in the inside, and near one end of the frame V V. On the opposite end of the frame V V, is a scale, divided into fiftieth parts of an inch, to adjust the length of the straight lines, previous to drawing them; the zero of which scale coincides with the fiducial edge of the frame A A, when the latter is equally distant from each end of the frame V V, and is figured or numbered both ways, so as to show at once the eccentricity of the square frame A A, which can be fixed either concentric or eccentric, in any required position, by the two nuts *c d*, being screwed close to the stud or stop *w*; and in order to limit the action of the instrument, a screw W W, is fixed into two studs, attached to the frame A A, which passes freely through a hole in another stud *w*, affixed to the frame V V; on this screw, which has 50 threads to the inch, are two moveable nuts *c d*, each having a short cylinder upon it, the circumference of which is divided into ten equal parts, and each of these, is again subdivided into two others, making them equal to the thousandth part of an inch. Having described the ellipsis *a a*; in order to draw the two sides *b b*, of the cylinder, the square frame A A, is made concentric with the frame V V, and the nut *c*, is turned upon the screw W W, to limit the length of the sides of the intended cylinder; the square frame A A, is then at liberty to move to the right, as far as the stop or nut *c*, will permit it to do; but previous to this, the radial bars must be brought parallel to the sliding bar C C,

when the drawing pen or pencil will be at one end of the transverse diameter of the ellipsis; the milled head *v*, of the rack pinion, being then turned, will carry the square frame A A, together with the drawing pen, parallel to the side of the frame V V, to the extent limited, as aforesaid, by the nut *c*; and the straight line *b*, forming one side of the cylinder will be drawn; when, by making half a turn of the winch E, the semi-ellipsis *e e*, forming the base of the cylinder will be drawn, and the cylinder completed, by carrying the frame A A, back again to its first situation, by again turning the milled head *v*, of the rack pinion the contrary way. When a cylinder is perpendicular to the centre of the picture, the transverse axis of the ellipsis will be at right angles to the sides of the cylinder, and such as is already described; when, however, the cylinder is posited to the right or left of the centre of the picture, and cut by a plane above or below the horizontal line, the ellipsis will be more or less oblique to the sides of the cylinder, according to its distance from the centre of the picture; in order to accommodate the instrument to draw the ellipsis under these circumstances, a provision is made, by which the lower radial bar P P, can be turned upon its axis H, to any angle and retained there; thus, in order to draw the ellipsis *f f*, the lower radial bar P P, is moved to a right angle, with the upper radial bar D D, as shown by the dotted lines *g g*, when the ellipsis *f f*, may be drawn by turning the handle E, of the instrument round as before, but this ellipsis *f f*, will be made greater in both its diameters, in proportion as the ellipsis *a a*, is to the ellipsis *f f*, in consequence of the lower radial bar P P being moved to that angle with the upper one D D, and this notwithstanding the adjustments of the radial bars remain the same. By moving the lower radial bar P P, to the opposite right angle with the upper one D D, another ellipsis might be drawn, the axis of which would be at right angles to the ellipsis *f f*; if, however, it be

turned half round, or be brought parallel with the upper radial bar D D, the situation of the drawing pen will be reversed in regard to its first position, and the conjugate and transverse diameters of the ellipsis will become completely changed; the conjugate diameter will also be equal in length to the transverse diameter of the ellipsis *a a*, and its transverse diameter double thereto: nevertheless, were the lines *b b*, to be produced, the boundary lines of all these various ellipses would touch those lines, or be contained within those parallels. The two radial bars may also be moved into any intermediate positions so as to draw the ellipsis in any situation required; but when the lower radial bar is reversed to its first position, and parallel to the upper one, the properties of the micrometer screws I and X, are also changed. Thus, if the lower radial bar P P, be adjusted to describe a given circle *h h h h*, fig. 1, plate XX, then, by moving the micrometer screw I on the upper radial bar alone to different distances, so many various ellipses will be described, the conjugate axis of all which will be equal to the diameter of the circle *h h h h*; but their transverse axis may be extended to any degree within the limits of the instrument. If the length of the transverse and conjugate diameters be given, to describe an ellipsis when the instrument is in this situation, the lower radial bar P P, must first be adjusted to the conjugate diameter, and then the upper one to the transverse; but if ellipses be required to be described within the given circle *h h h h*, the lower radial bar must be turned to the first-mentioned position, and will remain equal to the radius of the circle; and the upper radial bar must be adjusted to zero; then, by screwing forward the upper radial bar, all the various ellipses may be described within the given circle, to a straight line passing through its centre, their transverse axis being all equal to the diameter of the circle.

If when the instrument is in this latter position, the lengths of the transverse and conjugate diameters of any required ellipsis be given, the lower radial bar P P, must first be adjusted to the transverse diameter, and the upper one D D, to its conjugate.

In order to render the use of the instrument more convenient, the frame V V, is mounted upon a circular, base or flat ring Y Y, the inside of which is bevelled as shown at Y Y, fig. 2, of plate XVIII, to receive four pieces *i i i i*, fig. 1, and *i i*, fig. 2, screwed to the under side of the frame V V, and capable of being so adjusted, as to make the centre of the frame V V, exactly coincide with the centre of the circle Y Y.

This circle is divided into 360 equal parts, or degrees, and these are again subdivided into 10 others, by the nonius, which is equal to 6 minutes.

Z, is the nonius, fixed to the underside of the frame V V, and can be carried round the circle Y Y, by turning the milled head *j*, of a pinion, which works into teeth, cut round the circumference of the circle.

An important application of the instrument in this state is to describing the teeth of wheels or pinions, in geometrical drawings. Thus, let the dotted line *a a*, fig. 2, plate X X, represent the bottom of the teeth of the wheel A, and the dotted line *b b*, their tops; let the lower radial bar P P, be turned half round, so as to be in a line with the upper one D D, and their micrometer heads on opposite sides of the axis; and adjust the micrometer screws I and X, to their zeros, and likewise the frame A A, to zero on the divisions on the frame V V. The instrument must then be so placed on the drawing, that the tracer point coincides with the centre of the intended wheel A; the nonius Z, must likewise be brought to its zero; the frame A A, must be moved eccentric, equal to the radius of the dotted line *a a*, and be fixed by the two

nuts *c d*, of the screw W W. The micrometer head of the lower radial bar P P, must be adjusted to the radius of the conjugate diameter of the intended semi-ellipsis, which is to form the teeth; and that of the upper one D D, to the radius of the transverse diameter of that semi-ellipsis, the number of teeth, and spaces of the intended wheel A, having been previously ascertained; the radial bars must then be brought parallel to the upper sliding bar C C; and by turning the winch or handle E, half round, the semi-ellipsis, or one tooth of the intended wheel A, will be described; then the nonius Z, must be turned, equal to the distance of the space between the bottoms of the teeth, by means of the pinion *j*; the tracer point must be slided up, and the winch brought back to its former situation; the nonius Z, must then be again turned, until the tracer point be found, when lowered, to coincide with the end of the segment, or bottom of the tooth last drawn; a second tooth may then be drawn in a similar manner with that already described, and the operation be continued until the whole be completed. In the centre of fig. 2, is described a similar wheel, but on a considerably reduced scale, in which the value of the instrument, for such operations will appear more evident.

In this manner, the teeth of the wheels in figs. 1 and 3, plate XVIII, were drawn upon the copper, by the instrument.

Another important application of it is, in describing the teeth of racks; in order to do which, the two radial bars D D and P P, must be brought parallel to each other, with their micrometer heads on the same side of the axis, and both be adjusted to their zeros; then let the dotted line *c c*, fig. 3, plate XX, represent the bottoms of the teeth of the intended rack; and the dotted line *d d*, their tops; the tracer point must then be placed in the dotted line *c c*; and the lower sliding bar C C, must be brought parallel to the said line, by turning the pinion

head *j*; the lower radial bar must then be adjusted to the radius of the transverse axis of the semi-ellipsis *e*, or tooth of the rack; and the upper radial bar to the radius of the conjugate axis; the radial bars must then be brought parallel to the lower sliding bar C C; and by turning the handle or winch E, half way round, one tooth will be described; then, by turning the nut *d*, on the screw W W, the tracer point will be moved along the dotted line *c c*, so as to describe the space between the bottoms of two of the teeth; the size of the teeth and distance between them, having already been determined upon; the tracer point must then be lifted up, and the winch be brought to its first situation, and the nut *d*, turned, until the tracer, when put down, will coincide with the end of the said line; the instrument will then be ready for delineating another tooth; and so on, until the whole are completed; and in this manner were the rack teeth in figs. 1 and 3, of plate XVIII, also drawn upon the copper by the instrument.

It is obvious, that the tops of the teeth of either wheels, pinions, or racks, may be cut off, and made segments of circles only, or parts of straight lines, in a manner nearly similar to those of the bottoms of the teeth, when needful.

The threads of screws, or helical springs of wire, seen in perspective, can also be readily divided and drawn by this instrument, when in this latter state, with a very slight variation in its adjustments: the radial bars must first be adjusted to their zeros; then, let the dotted line *f f*, fig. 4, plate XX, represent the axis of the intended helical spring, and the tracer point be placed upon that line, and also the parallelism of the instrument be adjusted with it, as before, for the racks; let the dotted lines *g g*, represent the sides or diameter of the spring; the coils of which will appear nearly as semi-ellipses, shown more or less oblique to the sides of the spring, according

to the rake of the coils, and the situation in which they may be viewed; the lower radial bar must then be adjusted to the dotted line *g*, or the radius of the transverse axis *f g*, and the upper one to the radius of the conjugate axis *f h*; this upper radial bar will require continual adjustment during the progress of the operation, according to the angle in which the helical spring is viewed; and the varying obliquity or rake of the coils must be produced by turning the lower radial bar, so as to form an acute angle with the upper one; the instrument being so prepared, the tracer point must then be brought to *h*, or the beginning of the coil; and by turning the winch or handle half way round, the semi-ellipsis *h g i*, will be drawn. Then move the frame A A, to the right hand, equal to the distance *f j*, and screw forward the upper radial bar, till the conjugate diameter is equal to *f i*; then place the tracer at the point *i*, and turn the winch or handle half round, and the line *i f g*, will be drawn; then screw back the upper radial bar to its former situation, and move the frame A A, to the right hand, till the tracer coincides with the point *f*, and, by turning the handle half way round, another semi-ellipse, equal to *h g i*, will be drawn; and in this manner the operation must be continued, until the whole of the lines, forming the coils of the helical spring, are completed.

Fig. 5, plate XX, is a sharp threaded screw, seen in perspective, situated to the left hand of the centre of the picture, and below the horizontal line. It must be obvious to every one, that the outline of this figure will be similar to the one above described; excepting that, in consequence of its being a solid, the back part of the screw will not appear; and we have therefore only to delineate those parts of the ellipses, which are visible, forming the tops of the threads, in the manner above described.

Fig. 6, plate XX, is a geometrical elevation of a

square threaded screw. In order to describe this with the instrument, first adjust all the indexes to their several zeros; then place the instrument with its lower sliding bar parallel and perpendicular to the dotted line *a b*, or axis of the intended screw; the radial bars must then be brought parallel and perpendicular to each other, and be placed at right angles to the line *a b*; next screw forward the lower radial bar, till the tracer point coincides with *c*, or the radius of the intended screw; then turn the winch E, till the radial bars are parallel and perpendicular to the lower sliding bar, and screw forward the upper radial bar, till the conjugate diameter of the ellipsis, is equal to *d e*, or the breadth of the thread of the screw; next, place the tracer point at *d*, and draw the line *d f*, by turning the winch E, one-fourth of a circle; then move the frame A A, in the direction *a b*, equal to the distance *f g*, or the breadth of the thread, by turning the nut *d*, on the screw W W: next place the tracer point at *e*, and draw the line *e g h* (forming the lower angle of the thread); then raise up the tracer, and turn the winch E, till the tracer coincides with *i*; then put down the tracer, and draw the line *i e j*, forming the angle on the upper edge of the face of the thread; then raise the tracer, and turn it back to the point *c*; then lower the tracer, and screw forward the nut *d*, on the screw W W, to *k*, equal to the distance *c k*, or the breadth of the thread of the screw, and it will describe the right line *c k*; then turn the winch E one fourth of a circle, and the line *k l*, will be drawn; then lift up the tracer, and turn the winch E, half round, and the tracer will coincide with the point *i*; lower the tracer, and draw the line *i m*, which is similar to the line *d f*, before described; and thus proceed, until all the lines, forming the upper and lower extreme angles of the threads of the intended screw, are completed. As the interior angle of the thread is more obtuse than that of the exterior one,

part of the line, forming the interior angle, will be seen on the upper side of the thread, to the right hand of the dotted line *a b*; and part of it on the under side, to the left hand of the said line; this remains yet to be drawn; in order to do which, the frame A A, must be moved back to its first position at *c*, or to zero. In order, however, to avoid the perplexity which would arise from the letters of reference being crowded so closely together, we shall describe this part of the operation as commencing at *n*, instead of at *e*, as it would have done in the regular order of proceeding. The radial bars being brought parallel and perpendicular to the upper sliding bar; screw back the lower radial bar, till the tracer coincides with the point *o*, or the radius of the cylinder, forming the bottom of the threads of the screw; then screw back the upper radial bar, till the conjugate diameter of the ellipsis would be equal to the distance *n q*, or the breadth of the thread of the screw; then put the tracer down at the point *n*, and turn the winch E, one quarter round, and the line *n o*, will be drawn; then move the frame A A, in the direction of *a b*, equal to the distance *o p*, and the right line *o p*, forming the cylindrical bottom of one side of the thread, will be drawn; then place the tracer at the point *q*, and draw the line *q r*; then move the frame A A, back to *s*, and the line *r s*, forming the opposite side of the bottom of the thread, will be drawn; and a repetition of similar processes will complete the operation.

Fig. 7, plate XX, is a geometrical elevation of a double square threaded screw; the diameter of the screw and the breadths of the top and bottom of the threads being equal to the single threaded one, above described in fig. 6. It will be obvious, that in fig. 7, the rake or angle which the threads make with the cylinder, will be double that of the single one; and the only difference in the

operation, will be, in making the conjugate diameter of the semi-ellipsis, double to that of fig. 6.

Another important use of the instrument is, that of drawing spiral lines, in any given proportion, and whether viewed direct or oblique.

In order to describe a spiral, similar to one generated by the unwinding of a thread from a cylinder, such as is represented in plate XXI, fig. 1, the radial bars must first be adjusted to their zeros, and brought parallel and perpendicular to each other; then move them into the situation shown in plate XX, fig. 1, so as to form an angle of 45° with the sliding bars C C; the winch or handle must then be set parallel with the lower sliding bar, so as to form an angle of 30° with the radial bars.

The frame A A, and nonius Z, must also be moved to their zeros; then place the tracer point at *k*, in the centre of the dotted circle *m n*, and the lower sliding bar C C, parallel and perpendicular to the dotted line *l l*; then move the frame A A, eccentric, in the direction of the dotted line *l l*, equal to the radius of the circle *k n*, and fix it in that situation, with the two nuts *c d*, on the screw W W. Then, if the instrument were turned round by the pinion *j*, the tracer point would describe the circle *m n*, which will be equal to the end of a cylinder, by which a similar spiral or volute might be drawn, by the unwinding of a thread *n v w x*, from the cylinder; the thread being represented in eight different situations by the dotted lines, all forming tangents to the circle *m n*. The distance between the lines in each turn of the spiral, will be equal to the circumference of the circle *m n*; and the lines will all be parallel to each other. Then, after having adjusted the instrument as before described, if the tracer point be put down, it will coincide with the point *n*, which will be the beginning of the spiral. Then, lift up the tracer point,

*

and turn the nonius Z, round 45° towards the left hand; then turn the radial bars the same way by the winch E, 45°, or nearly parallel to the upper sliding bar C C; and screw forward the lower radial bar, till the tracer point coincides with the point *n*; then put down the tracer point, and turn the winch or handle, till it is parallel to the upper sliding bar, or 45°, and the curve line *n o*, will be drawn; then pull up the tracer point, and turn the nonius Z, 45° more; then turn back the winch E, 45°, and screw forward the lower radial bar, till the tracer point coincides with the end of the line *o*; then put down the tracer point, and turn the winch, till it is parallel to the sliding bar C C, or 45°, as before described; and the curve line *o p*, will be drawn; then pull up the tracer point, and turn the nonius Z, 45° more, and adjust the tracer point as last described, to the end of the line *p*, and draw the line *p q*; and, by repeating the operations five times more, the curve line *q r s t u v*, will be drawn, which will complete one turn of the spiral or volute; a second turn *v w*, or any number of turns, may be drawn, by continuing the said operations.

If the spiral lines be near each other, an angle of 90° may be taken, in place of 45°, and the process will be shortened one-half. Or should the line expand very rapidly, 30° may be taken, or any other lesser number.

Fig. 2, plate XXI, is a spiral similar to one generated by the unwinding of a thread from a cone. After having adjusted all the indexes of the instrument to their zeros, as described in fig. 1, and placed the tracing point at *x*, on the dotted line *d y*, and the lower sliding bar parallel and perpendicular to it, then unscrew the nut *c*, of the screw W W, to the situation as shown in fig. 1, plate XVIII, and move the frame A A, eccentric in the direction *x y*, (by making one turn of the nut *d*, on the screw W W), equal to $\frac{1}{8}$th of the space *x z*; then put down the tracer

point, and a dot will be made near the centre or axis *x*, on the line *x y*; then turn the nonius Z, 45° towards the left hand, or in the direction of the intended spiral; then move the frame A A, eccentric (by turning the nut *d*), $\frac{1}{8}$th more of the space *x z*, and put down the tracer point, and a dot will be made on the line *x a* equal to $\frac{2}{8}$ths of *x z*; and, by repeating 14 more similar operations, two dots will be made on each line *x y*, *x a*, *x b*, *x c*, *x d*, *x e*, *x f*, and *x g*, forming two turns of a spiral, each dot being $\frac{1}{8}$th of *x z*, more eccentric than the other.

Then, if we suppose these dots to form the plan of a cone (*x* its axis), having a thread made fast at *i*, and wrapped twice round it in a spiral direction; if a tracer point be fixed at the other end of the thread, close to the axis *x*, and the thread be unwound from the cone, the volute or spiral line *x f*, would be generated. The same volute may easily be drawn with the compasses (on a large scale), by dividing a circle into 8 equal parts, and drawing lines from the centre through each of those divisions: set off 1 division, from a scale of equal parts from the centre, on one of these lines; then take 2 divisions, and set them off on the next line; 3, on the next; and, by continuing the operation till you have got twice round the circle, a similar set of points will be formed, to those above described by the machine; then take in your compasses an extent equal to $\frac{1}{8}$th of *x z*, or equal to one of the above parts; and place one point on the first dot, next to the centre *x*, on the line *x y*; and from *x*, describe the line *x* 1; then place them on the dot on the line *x a*, and extend them till they coincide with the end of the line 1, and describe the line 1, 2, equal to 45°; then place them on the third dot, on the line *x b*; and extend them, till they coincide with the end of the line 2, and describe the line 2, 3, equal to 45° more; and, by continuing similar opera-

tions, the spiral line *x*, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, will be completed; and may be continued to any number of turns, by the same process.

A spiral drawn by this rule, is not mathematically correct; but so nearly so, that the eye can scarcely perceive the difference, where the arc is not more than 45°. But should a number of lines or mouldings be required, it is impracticable to draw them by the compasses; for the centres would be so near each other, that the paper would be entirely destroyed by the point of the compasses.

On the above principle, the volutes or spiral lines, used in architecture, are drawn by the machine, and they may be drawn on a large or small scale at pleasure; and any number of lines or mouldings may be drawn, proportional to the first, as is shown in fig. 2; as no centre holes, or lines are required to be made on the paper or place where the volute is drawn. In order to do which, after having adjusted the instrument for making the spiral dots (as before described, in explaining the principle of a spiral generated from a cone,) in place of making the dot in the line *x y;* screw forwards the lower radial bar, until the tracer point coincides with the axis or centre *x;* then turn the winch E, 45° and the line *x* 1, will be drawn; then raise up the tracer point, and turn the nonius Z, 45° towards the left hand, and move the frame A A, eccentric towards the left hand (by making another turn of the nut *d*, on the screw W W), equal to $\frac{1}{8}$th more of the space *x z;* then turn back the winch 45°, and screw forwards the lower radial bar, till the tracer point coincides with the end of the line 1; then turn the winch in the direction of the spiral 45°, and the line 1, 2, will be drawn; and, by repeating this series of operations 14 times more, the spiral line *x*, 1, 2, 3, 4, 5, 6, &c. will be completed; and by the same process, any number of turns may be made, within the limits of the instrument, in proportion to the first, by

turning the nonius Z, after the first spiral line is drawn, ten or any other number of degrees, according to the distance between the two lines. If it be turned to the right hand, the line will be on the outside of the first line; and if to the left, it will be on the inside.

Fig. 1, plate XXII, is a spiral line (similar to one which would be generated by the unwinding of a thread from a cylinder), viewed obliquely. To draw a similar one by the instrument, all the indexes must be adjusted to their zeros, and the lower radial bar turned half round; then place the instrument with its sliding bar C C, parallel and perpendicular to the dotted line *b b*, with the tracer point in the center of the ellipsis *a;* then turn the radial bars, parallel to the upper sliding bar, and screw forwards the lower radial bar, till the tracer point coincides with the conjugate diameter; then turn the radial bars parallel and perpendicular to the lower sliding bar, and screw forwards the upper radial bar, till the tracer point coincides with the transverse diameter, and draw the ellipsis *a;* then see in what proportion the indexes on the radial bars are to each other. If they both stand at the same number, the process will be simple; but if the numbers vary, the use of the sliding rule, is to be preferred; for they must (in this case) bear the same proportion to each other, throughout the whole figure. In this figure, as both indexes stand at 5, screw forwards both the radial bars to 10, and unscrew the nut *c*, on the screw W W, till the frame A A, can be moved eccentric to the right hand, by turning the head of the pinion *v*, till the tracer point coincides with the end of the ellipsis *c;* then turn the winch E, half round, in the direction of the spiral, and the line *c d*, will be drawn; then screw forwards the radial bars, each 5 divisions, or to 15; and move the frame A A, towards the left hand, by turning the head of the pinion *v*, till the nut *d* stops against the stud or stop *w* (the frame A A, will then be in

its first situation); then put down the tracer point, and draw the line *d e;* then adjust the radial bars to 20, and move the frame A A, towards the right hand, till the nut *c*, stops against the stud *w*, and draw the line *e f*. It would be needless to dwell longer upon the description of this figure, as it will be easily seen, that by repeating similar operations, any number of turns may be made, within the limits of the instrument.

Fig. 2, plate XXII, is an oblique view of a spiral line, similar to one generated by the unwinding of a thread from a cone.

To prepare the instrument for this figure, all its indexes must be adjusted to their zeros, having the lower radial bar in the reversed position to the upper one, as in the last example; then place the machine on the dotted line *g h*, with its lower radial bar parallel and perpendicular to the said line, with the tracer point in the center of the figure; make a dot *i*, with the tracer point, and lift it up. Then screw back the nut *c*, on the screw W W, one turn, and move the frame A A, in the direction of the dotted line *i g*, by turning the pinion head *v*, till the nut *c*, stops against the stud *w* (the radial bars in this figure must likewise bear the same proportion to each other throughout the whole figure; for simplicity we shall again take the same number on each radial bar); then adjust the radial bars, parallel and perpendicular to the lower sliding bar C C; then screw forwards each radial bar, till the tracer point coincides with the center or dot (observing that the micrometer heads both stand at the same numbers); then turn the winch half round, and the first semi-ellipsis *i k*, will be drawn. Then unscrew the nut *d*, on the screw W W, one turn; and move the frame towards the left, by turning the pinion head *v*, till the nut *d*, stops against the stud *w;* then screw forwards the radial bars, till the tracer point coincides with the end of the line last

drawn (again observing that the micrometer heads both stand at the same number); then put down the tracer point, and turn the winch half round, and the line *k l*, will be drawn; then turn back the nut *c*, one turn, as before described, and move the frame A A, towards the right hand, till the nut *c*, stops against the stud *w*, and adjust the radial bars till the tracer point coincides with the end of the line *l;* then turn the winch half round, and the line *l m*, will be drawn; then turn back the nut *d*, one turn; and move the frame A A, towards the left hand, till the nut *d*, rests against the stud *w;* then adjust the radial bars, till the tracer point coincides with the end of the line *m;* then turn the winch half round, and the line *m n*, will be drawn. By this time, the reader will be able to understand its progression; and by continuing the same operations, a beautiful spiral will be delineated. By the same rules, spiral lines may be drawn to expand in any given proportions, and more or less oblique, from a circle to a straight line.

Another valuable application of the instrument is, to delineate geometrically or perspectively, the lines of latitude and longitude on the sphere.

Fig 1, plate XXIII, is a geometrical projection of the sphere, with its poles N. S. parallel to the plane of the picture. In order to draw the sphere in this situation, all the indexes of the instrument must first be adjusted to their zeros; then having drawn the temporary line N S, the instrument must be placed on the paper, with its upper sliding bar, parallel to, and perpendicular with, that line, or the intended axis of the sphere N S, having the tracer point in the centre of the line N S; then screw forwards the lower radial bar, to the intended diameter of the sphere; and turn the nonius Z, round 10°, and make a dot with the tracer point, upon the paper; then move it 10° more, and make another dot, and so on, at each 10°, till

the circle is completed; then screw back the nuts *c* and *d*, on the screw W W, till the frame A A, has liberty to move, equal to the diameter of the sphere; then screw back the lower radial bar, at the same time moving the frame A A, till the tracer point coincides with the first dot, or division of 10° from the pole N, or of 80°, from the equator W, and move the frame A A, towards the right hand, by the pinion head *v*, till the tracer point has reached the dot on the other side of the axis; and note down the number of the micrometer head; then take up the tracer point, and turn the winch half way round, and the tracer point will coincide with the dot at the first 80° from the equator E, on the right hand side of the pole S; then put down the tracer, and move the frame A A, towards the left hand, till the tracer arrives at the opposite dot or division, on the left side of the pole S; then lift up the tracer, and screw back the lower radial bar, at the same time moving the frame A A, as before, until the tracer coincides with the point of 70°, or the second dot from the pole S, and carry it along to the opposite point; again removing it to the opposite pole N, repeat the operation, noting down as before the number of the micrometer head, and so on successively, through each 10°, until the tracer has arrived at the equatorial line W E, which must also be drawn. Then fix the frame A A, by the nuts *c* and *d*, on the screw W W, at zero; then turn the nonius Z, half round, and set the radial bars parallel to the lower sliding bar, and axis N E, of the sphere; then screw forwards the lower radial bar, till the tracer point coincides with the end of the pole N, and turn the winch once round, which describes the circumference of the sphere, and note down the number of the micrometer head; then screw forwards the upper radial bar, till the tracer point coincides with the line at 80° from the equator; then turn the nonius Z, half way round, back again, and put down the tracer point, and turn the winch once round; and the ellipsis or

longitudinal line of 10° within the sphere will be drawn; then turn the nonius Z, back again 90°, and screw forwards the upper radial bar, till the tracer point coincides with the 70th degree of latitude; then turn the nonius Z, back to its last situation; put down the tracer point, and turn the winch round, which will describe a second ellipsis, or the longitudinal line of 20°: in the same manner all the other ellipses or lines of longitude must successively be drawn, and lastly, the straight line or axis of the sphere N S; then turn the nonius Z, 45° towards the left hand; put down the tracer point, and draw the line *e f*, the use of which will be described hereafter.

Fig. 2, plate XXIII, is another geometrical view of the sphere, with the pole N in its centre. In order to delineate this, adjust all the indexes to their zeros, and draw the temporary line *a b;* and place the instrument with its tracer point at N, in the said line, or the centre of the intended sphere, with the upper sliding bar parallel and perpendicular to that line; then screw forwards the lower radial bar, till the micrometer head stands at the number already noted down, as directed in drawing the circumference of the last figure; put the tracer point down, and turn the winch round, which will describe the circumference or equator of the intended sphere; then screw back the lower radial bar, till the micrometer head stands at the same number as noted down, when it drew the latitudinal line of 80° from the equator in fig. 1; turn the winch round, and draw the second circle, or first latitudinal line from the equator in fig. 2; then again screw back the lower radial bar, till the micrometer head stands at the same number as when the latitudinal line of 70° from the equator, in fig. 1, was drawn; turn the winch round, having first put down the tracer point, and drawn the third circle in fig. 2, or latitudinal line of 20° from the equator; and in the same manner repeat the operation, until all the latitudinal lines of fig. 2 are completed; then

screw back the lower radial bar to zero, and place the radial bars parallel and perpendicular to the upper sliding bar; then screw back the nuts *c* and *d*, on the screw W W, and move the frame A A, towards the left hand, till the tracer point coincides with the diameter of the sphere; then move the frame A A, towards the left hand, till the nut *d*, stops against the stud *w*; then put down the tracer point, and move the frame A A, towards the right hand, until the nut *c*, stops against the stud *w*, and the longitudinal line W E, will be drawn; then move the nonius Z, 10° towards the left hand; and move the frame A A, towards the left, until the nut *d*, stops against the stud *w*, as before described; and, putting down the tracer point, and moving the frame A A, towards the right hand, until the nut *c*, stops against the stud *w*, the longitudinal line of 10° from the last line, will be drawn: in the same manner, may all the remaining longitudinal lines be drawn, and the figure will be completed.

When this operation is finished, the upper radial bar will be parallel and perpendicular to the line *a b*; then turn the winch, till the radial bars are parallel and perpendicular to the lower sliding bar, and screw forwards the lower radial bar, till the tracer point coincides with the first circle or equatorial line of the sphere at W; then take the line of 45° from a sector in a pair of compasses, and set it off from the pole N to *e*, on the line N W; then screw forwards the upper radial bar, until the tracer point coincides with the point *e*; then put down the tracer point, and turn the winch round; and the ellipsis, *e a f b*, will be delineated, which is the horizontal projection of the line *e f*, in fig. 1; and the use of which we shall hereafter describe; then note down also the numbers at which the micrometer heads of the two radial bars stand.

Fig 1, plate XXIV, is a geometrical projection of a sphere, with its axis elevated at an angle of 45° to the plane of the picture. All the lines of longitude and latitude in

this situation of the sphere, will become ellipses, excepting the right line, which passes through its centre; and in order to delineate them with the instrument, first find the situations of the transverse axis of the ellipsis, which form the longitudinal lines; which will be done by drawing the line *e f*, fig. 1, plate XXIII, or the ellipsis *e a f b*, fig. 2, which will be parallel to the plane of the intended sphere or picture, when the pole is elevated 45°, and will cut the longitudinal lines at its greatest extremity, which will be the transverse axis of the required ellipsis; then take the radius of the sphere in a pair of compasses, and extend the line of sines upon a sector, till the points of the compasses coincide with 90°; then place one leg of the compasses in the centre of the sphere, fig. 1, plate XXIII, and extend them along the line *e* to the first intersection at *e* of the longitudinal line of 80°, and apply that opening to the sector, which will be equal to 14°; then, extend the compasses to the second intersection, at *u*, of the longitudinal line of 70°, which will be found, by applying to the sector, to be 27·2°; then extend the compasses to the intersection at *s*, of the third longitudinal line of 60°, which will be found in the same manner, to be equal to 39·25°, and thus proceed till all the intersections of the longitudinal lines are measured, which will be equal to the following numbers, viz.:

| | | | | |
|---|---|---|---|---|
| Degrees of Longitude. | | 90 | = 0 | Degrees from the centre of the sphere to the intersection of the longitudinal lines, with that of the right line *e f*. |
| | *w*, | 80 | = 14° | |
| | *u*, | 70 | = 27·2 | |
| | *s*, | 60 | = 39·25 | |
| | *q*, | 50 | = 49·9 | |
| | *o*, | 40 | = 59·3 | |
| | *m*, | 30 | = 67·8 | |
| | *k*, | 20 | = 75·56 | |
| | *h*, | 10 | = 82·9 | |
| | | 0 | = 90 | |

As, however, this mode of finding the transverse axis of the longitudinal ellipsis, is difficult to effect, as we approach towards the circumference of the sphere; it is necessary to proceed in another manner to find the transverse axis of those ellipses, and which will be more accurate in those parts where the first method is deficient, although it is less so in others where the first mode is perfect, and we shall thus attain an equal degree of perfection throughout the whole; in order to which the ellipsis *e a f b*, fig. 2, plate XXIII, has been prepared; then where the ellipsis intercepts the radial or longitudinal lines, through these points draw lines, *g h*, *i k*, *l m*, &c. parallel to the line W *e*, from the intersections to the circumference of the sphere; which will cut the arc W *b*, of the sphere, in the same number of degrees from 90°, as in the former operation; then take the radius of the sphere in a pair of compasses, and extend the sector till 60° on the line of chords coincides with that distance; then place one leg of the compasses at the longitudinal point 90°, and extend the other to the point *v*, where the parallel line *v w*, cuts the circumference of the sphere; and apply that distance to the line of chords on the sector, which will be found equal to 14°: in like manner measure the arc from 90° to *t*, which will be found equal to 27·2, as will also the arc from 90° to *r*, be equal to 39·25, and so on through the remaining points *p*, *n*, *l*, *i*, *g*, and W, which will all be found to correspond with those in the above table.

By a similar process, the transverse axis of the longitudinal ellipsis may be found for any other elevation of the poles. They may also be obtained by means of logarithms. After having found the positions of the transverse axis of the longitudinal ellipses, as before described, we shall now proceed to point out the manner of finding the lengths of the conjugate axis; in order to accomplish

which, we must first be prepared with a scale of equal parts, to correspond with the divisions on the radial bars of the instrument, each of which is equal to the 1000th part of an inch; then with a pair of compasses take the radius N *f*, of the conjugate diameter of the ellipsis *e*, *a*, *f*, *b*, fig. 2, plate XXIII, which will be equal to the distance of the poles from the centre of the intended sphere, and extend the line of sines on the sector until 90° coincides with that distance; then subtract the sine of 90° from the radius of the sphere, and the remainder will be the number that the upper radial bar must be adjusted to.

It will now be necessary to construct a table of the numbers on the radial bars, and the degrees corresponding with the transverse diameters on the circular plate of the instrument Y Y, as follows:

For example: let the radius of the sphere be equal to 2,000, or 2 inches; then the radius of the conjugate diameter of the ellipsis *e a f b*, equal to 1405, being subtracted from 2,000; there will remain 595, which will be the first number on the upper radial bar; then take 80° in the compasses from the line of sines on the sector, which, applied to the scale of equal parts, will be found to be 1383; this number being also subtracted from 2,000 there will remain 617, which will be the second number to be found on the upper radial bar.

In like manner must numbers be found corresponding to the remaining degrees, and the whole arranged in a tabular form, thus:

| Positions of the Transverse Axis, in Degrees on the Circular Plate Y Y, or the Nonius Z. | Numbers on the Lower Radial Bar. | Numbers on the Upper Radial Bar. |
|---|---|---|
| 0 | 2·000 | 59·5 |
| 14° | 2·000 | 61·7 |
| 27·2 | 2·000 | 68·1 |
| 39·25 | 2·000 | 78·6 |
| 49·9 | 2·000 | 92·5 |
| 59·3 | 2·000 | 109·7 |
| 67·8 | 2·000 | 129·8 |
| 75·56 | 2·000 | 152·0 |
| 82·9 | 2·000 | 175·5 |
| 90· | 2·000 | 2·000 |

Fig. 2, plate XXIV, represents the lines of longitude of the above sphere, consisting of a right line *k k*, passing through the poles, and a series of ellipses, the transverse axes of all which are equal to the right line *k k*, or diameter of the sphere; then, in order to delineate this figure, the instrument must first have all its indexes adjusted to their zeros; then place the lower sliding bar parallel and perpendicular to the assumed right line *k k*, and the tracer point in the centre of that line; then screw forwards the lower radial bar, until the tracer point coincides with the diameter of the sphere; for example, say at the division of 2,000 on the radial bar, equal to two inches, or the radius of the intended sphere; then screw forwards the upper radial bar as above described, which will be equal to 59·5, as in the before-mentioned table, namely, to the division of 5 on the radial bar, and 9·5 of the micrometer head on the screw of that bar; then put down the tracer point, and turn round the winch, and the ellipsis *a a*,

or that having the greatest conjugate diameter, will be drawn, and which answers also for the equatorial line, and is indeed similar to that already drawn in fig. 2, plate XXIII; then turn the nonius Z to 14° towards the right hand, and screw forwards the upper radial bar to 61·7, namely, to the 6th division on the bar, and to 1·7 on the micrometer head of that bar; and having put down the tracer point, and turned the winch once round, the second ellipsis *b b*, will be drawn; the nonius Z must then be turned backwards 14° towards the left hand from zero; and the tracer point being put down by turning the winch round, the ellipsis 1 1, will be drawn, which will be similar to the ellipsis *b b*, already drawn; next turn the nonius Z towards the left hand, to 27·2°, and screw forwards the upper radial bar to 68·1°, and describe the ellipsis 2 2, also carry the nonius to 27·2° on the right hand of zero, and describe the ellipsis *c c*, and by continuing similar operations, and taking the succeeding numbers as they stand in the table, may all the other ellipses of that figure be delineated.

Having thus described all the ellipses forming the longitudinal lines of the intended sphere, the next step necessary will be, to point out the manner of finding the transverse and conjugate diameters of the ellipses, forming the latitudinal lines; the length of the transverse axes will be equal to the length of the latitudinal or straight lines in fig. 1, plate XXIII: if we then take half the length of any one of these lines in a pair of compasses, and apply it to the scale of equal parts before described, a number will be found which, when transferred to the divisions on the lower radial bar, will be the radius of the transverse diameter of one of the intended ellipses, or equal to the radius of one of the circles in fig. 2, plate XXIII: for example, let us take half the length of the line extending from 80° to 80° in fig. 1, plate XXIII, which will be equal to

346, on the scale of equal parts; then screw forwards the lower radial bar to that number. To find the conjugate diameters, project lines at right angles to the line *e f*, from each extremity of the latitudinal lines; for example, that from 80° to 80°, the distance between which will be equal to 240, which number, being subtracted from 346, there will remain 106; the upper radial bar must be then screwed forwards to that division, and the instrument will be prepared for drawing the two smallest ellipses in fig. 1, plate XXIV, or the latitudinal lines at 80° from the equator; in order to do which the nonius Z, must remain at zero, as when the first ellipsis *a a*, fig. 2, was drawn; then, with a pair of compasses, take the distance from 90° to 80° on the line *e f*, fig. 1, plate XXIII, and set it off from both the poles, towards the centre of the intended sphere, fig. 1, plate XXIV: then unscrew the nuts *c* and *d* on the screw W W, till the frame A A, can pass either to the right or left of its zero, or till the tracer point coincides with the division last set off with the compasses, from the poles on the right line, fig. 1, plate XXIV; turn the winch round, and one of the smallest ellipses will be drawn; then, observe the number on the scale V V, that the fiducial edge of the frame A A, stands at on that scale, and move the frame A A, to the same number on the other side of the zero of that scale, and the point of the tracer will coincide with the distance set off with the compasses, and the ellipsis which surrounds the other pole may be drawn.

In like manner the ellipses which form the remaining latitudinal lines may be found and delineated; but the extremities of the transverse and conjugate diameters of the ellipses forming the latitudinal lines will be more readily and accurately found by the use of the additionalor upper dividing plate 2, fig. 3, plate XVIII, which will be hereafter described. When all the longitudinal lines are completed, and the instrument adjusted to drawn the right line *k k*, then

place the radial bars perpendicular to the said line, and the commencement of the divisions on the dividing plate will coincide with the index 7 7 ; then adjust the index to that circle of divisions upon the plate 2, which is divided into 360°, and turn the dividing plate 5°, and make a dot with the tracer point on the line *k k* ; then turn the dividing plate, and make a dot at every 10° till it has been turned half round, when a sufficient number of dots will be made, which will be the conjugate diameters of the ellipses on each side of the pole, or the latitudinal lines. The transverse diameters of the above ellipses may be found by a similar process to the above ; the only difference is, to commence with turning the dividing plate 10° in place of 5°, and when completed it will be similar to a line of sines of 10° between each dot.

But the transverse diameters are already limited, as will be seen by the inspection of fig. 1, plate XXIV, which will be at the same points that the longitudinal lines intersect the equator.

We shall next proceed to describe the additional dividing plate and index, for dividing ellipses, geometrically and perspectively.

Fig. 3, plate XVIII, is a plan of the instrument in the operation of dividing an ellipsis geometrically, or as it would be divided by describing a circle around it, equal in diameter to its transverse axis, and dividing this circle into any number of equal parts ; these divisions are transferred to the included ellipsis, by drawing lines parallel to the conjugate diameter of the ellipsis through each division of the circle, until they meet the ellipsis. Geometricians, however, find this method of dividing ellipses exceedingly difficult in practice, when their conjugate diameters differ considerably from their transverse diameters ; or, when the ellipses approach near to a straight line.

To prepare the instrument for this operation, the winch or handle E, must be removed, and the circular frame 1 1,

&c. on which the additional dividing plate 2 2, is fixed, must be placed in its stead, and retained in the required situation, by means of the adjusting screw F, and the binding screw G: the toothed wheel 1 1, has three arms, and a number of flat rings round it, for the sake of lightness, and which also serve to support the dividing plate 2 2; the dividing plate is fixed to the wheel, by means of two screws passing through the grooves 3 3, in the opposite sides of the wheel, and screwing into square bosses formed in the under side of the dividing plate; under the head of each screw, is a thin spring or washer, which permits the bosses in the dividing plate to slide along the grooves 3 3, but affords sufficient friction to retain it in any required degree of eccentricity. The slide of one of the grooves 3 3, is divided into a scale of equal parts, and a tongue, or sliding piece fitted into the groove, and attached to the dividing plate, has a nonius upon it, for adjusting the eccentricity of the plate, when dividing an ellipsis perspectively; but when, as in the present instance, it is used for dividing the ellipsis geometrically, it must be fixed at zero, or concentric with the axis on which the wheel 1 1, is fixed. A short pillar, having a triangular hole through it, is firmly screwed to the end of the upper sliding bar C C; to this pillar two short arms are fixed, which support the axis of a pinion 5, which works in the teeth of the wheel 1 1, and has a winch or handle 6, to turn it; by this means the dividing plate can be moved and retained more accurately than by moving the wheel 1 1, by the hand. Through the upper end of the pillar 4, is another triangular hole, parallel to the lower one, through which passes the stem of an index 7 7, which can be fixed by a binding screw, in any required position; one edge of this index must be perpendicular to the centre of the upper sliding bar C C, and form a radial line to the axis of the wheel 1 1, and must also be bevilled to a thin fiducial edge, and have a line or mark in the middle of it; which line

may be adjusted to any of the circles of divisions upon the plate 2 2, by means of its binding screw, and serves to show that circle which is in use. The circles may be divided into any numbers which can be most readily subdivided by others; I have chosen the following, viz. 660, 600, 510, 390, 384, 360, 342, 336, 324, and 276; and for convenience in using the instrument, I have arranged the numbers, and those by which they can be subdivided, into a tabular form as follows, viz.:

| | | |
|---|---|---|
| 2 × 180 = 360 | 36 × 9 = 324 | 110 × 6 = 660 |
| 3 × 120 = 360 | 38 × 9 = 342 | 112 × 3 = 336 |
| 4 × 90 = 360 | 39 × 10 = 390 | 114 × 3 = 342 |
| 5 × 72 = 360 | 40 × 9 = 360 | 120 × 3 = 360 |
| 6 × 60 = 360 | 42 × 8 = 336 | 128 × 3 = 384 |
| 7 × 48 = 336 | 44 × 15 = 660 | 130 × 3 = 390 |
| 8 × 45 = 360 | 45 × 8 = 360 | 132 × 5 = 660 |
| 9 × 40 = 360 | 46 × 6 = 276 | 138 × 2 = 276 |
| 10 × 66 = 660 | 48 × 7 = 336 | 150 × 4 = 600 |
| 11 × 60 = 660 | 50 × 12 = 600 | 162 × 2 = 324 |
| 12 × 55 = 660 | 51 × 10 = 510 | 165 × 4 = 660 |
| 13 × 30 = 390 | 54 × 6 = 324 | 168 × 2 = 336 |
| 14 × 24 = 336 | 55 × 12 = 660 | 170 × 3 = 510 |
| 15 × 24 = 360 | 56 × 6 = 336 | 171 × 2 = 342 |
| 16 × 21 = 336 | 57 × 6 = 342 | 180 × 2 = 360 |
| 17 × 30 = 510 | 60 × 6 = 360 | 192 × 2 = 384 |
| 18 × 19 = 342 | 64 × 6 = 384 | 195 × 2 = 390 |
| 19 × 18 = 342 | 65 × 6 = 390 | 200 × 3 = 600 |
| 20 × 18 = 360 | 66 × 10 = 660 | 220 × 3 = 660 |
| 21 × 16 = 336 | 69 × 4 = 276 | 255 × 2 = 510 |
| 22 × 30 = 660 | 72 × 5 = 360 | 276 |
| 23 × 12 = 276 | 75 × 8 = 600 | 300 × 2 = 600 |
| 24 × 14 = 336 | 78 × 5 = 390 | 324 |
| 25 × 24 = 600 | 81 × 4 = 324 | 330 × 2 = 660 |
| 26 × 15 = 390 | 84 × 4 = 336 | 336 |
| 27 × 12 = 324 | 85 × 6 = 510 | 342 |
| 28 × 12 = 336 | 90 × 4 = 360 | 360 |
| 30 × 12 = 360 | 92 × 3 = 276 | 384 |
| 32 × 12 = 384 | 96 × 4 = 384 | 390 |
| 33 × 20 = 660 | 100 × 6 = 600 | 510 |
| 34 × 15 = 510 | 102 × 5 = 510 | 600 |
| | 108 × 3 = 324 | 660 |

The first of the three columns in this table points out numerically all the numbers, from the lowest to the highest, which can be obtained from this set of numbers; and the second column is the number which multiplied by the first, will be equal to the number in the third, which will be found upon the dividing plate 2 2.

We are now prepared to divide an ellipsis geometrically, as shown by the points or dots forming the ellipsis 8 8, fig. 3, plate XVIII. The lower radial bar must be screwed forwards to coincide with the transverse radius, and the upper radial bar, to the conjugate radius of the intended ellipsis, and the index 7 7, be set to that circle of the plate 2 2, which is divided into 360 parts; that number subdivided by 10 being equal to 36, or the number of points in the ellipsis; then place the mark in the middle of the index 7 7, so as to coincide with the number 360 on the dividing plate 2 2; put down the tracer, and make a dot; then take it up again, and turn the winch or handle 6, till the 10th division on the dividing plate coincides with the mark on the edge of the index; again put down the tracer point, and thus proceed until all the points are marked round the intended ellipsis, when each side and each end of it will be found to be divided similarly. If, however, the radial bars were so adjusted as to describe a right line instead of an ellipsis, the divisions on such line, made by the above process, would be found to be equal to a line of sines, extending each way from the middle of the line, which is of essential importance in representing the teeth of wheels, viewed edgewise, as in fig. 4, plate XX.

In dividing ellipses perspectively, the dividing plate 2 2, must be moved eccentric along the grooves 3 3, in the wheel 1 1, so as to coincide with the distance of the vanishing point, and centre of the picture.

Previously, however, to making use of the machine for this purpose, it will be necessary for the reader to be acquainted with the rules of perspective; at least so far as

to be able to delineate the squares in which the circles or ellipses are to be described, in their various situations to the plane of the picture; as for example, let a perspective square be given; to find the positions of the transverse and conjugate diameters of an ellipsis, to be delineated therein.

Fig. 1, plate XXV, A B C D, is a perspective square parallel to the horizon H L, and at right angles to the plane of the picture; and likewise situated to the left hand of the centre of the picture S, let *d*, be the distance of the eye from the picture; and G R, the ground line. Then, bisect the side of the perspective square C D, in E: and draw a line from thence to the centre of the picture S, which also bisects A B, in F; likewise bisect the sides A C and B D, in I and J; and draw a line through those points, cutting the line E F at K (which will be the centre of the ellipsis); next, let fall a perpendicular from E, and make E M, equal to the line I K; join K M; bisect that line at N, and through N, draw O P, at right angles to it, cutting G R, at O; then O, is the centre, from which, with a radius equal to O M, or O K, describe the semicircle Q M T, cutting G R, in Q and T; then draw the lines Q Z and T U, through the centre K, which will be at right angles to each other; and in the position of the transverse and conjugate diameters of the intended ellipsis.

It will next be necessary to find four, or which is more correct, eight points, through which the ellipsis must pass; this will be easily performed by converting the perspective square into an octagon, in the usual manner, and drawing the two perspective diagonals A D and B C, intersecting each other at *k*, which will be the perspective centre of the ellipsis; then through the centre *k*, draw the line *i j*, parallel to A B or C D; and *i l* F *a j n* E and *p*, will be the eight points required. It will however be necessary, previous to applying the instrument, to extend the lines forming the transverse and conjugate diameters, each

way from the centre, at least equal to the radius of the circular plate Y Y; then after having adjusted all the indexes of the instrument, to their zeros, place the lower sliding bar parallel and perpendicularly over the line T U, or the conjugate diameter extended; and the upper sliding bar to that of Q Z, or the extended transverse diameter; and likewise the two radial bars; then screw forwards the lower radial bar, till the tracer point coincides with the point *p*; then turn the radial bars a quarter round, until they are nearly parallel to the lower sliding bar, or to the line T U; then screw forwards the upper radial bar, till the tracer point coincides with the point *l*, on the line A D; then if the winch or handle be turned round, the tracer will pass through the eight points *l*, F, *a*, *j*, *n*, E, *p*, *i*; and the ellipsis will be delineated in the given square. If, however, a greater number of divisions be required, they may, I believe, be more easily performed by means of this instrument, than by any other method hitherto published. For example, suppose it be required to be divided into 64 parts; first, turn round the radial bars, until the tracer coincides with the point or division E, and loosen the binding screw G, which fixes the wheel 1 1 on the axis of the radial bar D; and turn the wheel 1 1 (without moving the radial bars), till the middle of the groove 3, which has the nonius in it; or where the numbers on the dividing plate 2 2, are marked, coincides with the fiducial edge of the index 7 7; the binding screw G, must then be tightened, to retain it in that situation; then turn round the wheel 1 1, till the tracer coincides with the point *i*, and slide the dividing plate along the grooves 3 3, eccentric, till the fourth part of that circle of divisions, which may have been selected from the above table, to divide the ellipsis into 64 parts: for instance 384 (that number divided by 6 being equal to 64), coincides with the fiducial edge of the index 7 7,

the mark upon the centre of which must also be adjusted to that circle of divisions, from time to time, as the operation proceeds, owing to its eccentricity, by sliding the stem of the index in its triangular hole in the pillar 4; then, if the dividing plate be turned one eighth of the circle, the tracer will be found to coincide with the point *l*; and by moving it another eighth, or half way round, the tracer will be at the point F; and by thus continuing the operation, or turning the plate one eighth at each interval, the tracer will be found to coincide successively with the points *a*, *j*, *n*, E, *p* and *i*, of the ellipsis before described, according to the rules of perspective.

The instrument is now properly adjusted to divide the ellipsis into 64 parts, or any other number, which 384 will admit of.

It will however be necessary to observe, that the perspective divisions will be the greatest, when that part of the circle of divisions on the dividing plate, which is the least eccentric, is brought to coincide with the fiducial edge of the index 7 7.

It will also be proper to observe, that the tracer must be adjusted to the point E, before the wheel 1 1, is fixed in the above situation, in all cases where the circles are at right angles to the plane of the picture; as the line E F, passes through the perspective centre *k*, to the centre of the picture S; and the divisions at E, being nearest to the eye (on the given circle), will appear the greatest; and those at F, the farthest from the eye, will be the least; but when the circle becomes an ellipsis, the divisions at the extremities of the transverse diameter, will of course be foreshortened; and appear still smaller, as the circle is situated on a plane, nearer to the horizontal line.

If the circle be situated opposite to the centre of the picture; the transverse axis of the ellipsis will be at right angles to the line S W, and the tracer must be adjusted to

the point W, in place of E, in fig. 1, as the line W S, will pass through the perspective centre of the ellipsis *(See* plate XIV.)

Fig. 2, plate XXV, A B C D, is the perspective representation of a geometrical square, containing a circle situated perpendicularly to the horizon, and obliquely to the plane of the picture.

Before applying the instrument to perform this operation, it will however be necessary, to find the situations of the transverse and conjugate diameters of the ellipsis, which is to be delineated in the square; which will be done, by bisecting the line D C, in E, and from that point, drawing a line E *v*, to the vanishing point *v*, in the horizontal line H L; and which will also bisect the line A B, in F; the lines A C and B D, must also be bisected by the line I J, passing through the centre of the ellipsis at K. Then from E, draw a line E M, at right angles to the line D C, or parallel to the horizontal line; and take the distance K I, and set it off from E, on the line E M; next, draw a line from M to K, and bisect it at N; through the point N, draw a line at right angles to the line M K, cutting D C, at O; then with the distance K O or O M, describe a semi-circle from the point O, cutting the line D C, at T and Q; then from the point Q, draw a line through the centre of the ellipsis K, and likewise another from the point T, which will be the situations of the transverse and conjugate diameters of the ellipses, as required: the line Q K, must then be extended each way, and the instrument be placed parallel with it, as in fig. 1. The same process of converting the square into an octagon, &c. as directed in that figure, must also be repeated in this case, to determine the extremities of the ellipsis; the principal difference between the two operations consisting in the line E F, of fig. 2, being drawn to

the vanishing point *v*; instead of being drawn to the centre of the picture S, as in fig. 1.

Plate XXVI, is another example of an important use of this instrument, being the perspective representation of a cylindrical toothed wheel, lying parallel to the horizon, and opposite to the centre of the picture. The horizontal line being 6 inches above the perspective centre of the wheel; and the distance of the eye, 12 inches. Before using the instrument, temporary perspective squares (equal in diameter to the tops and bottoms of the teeth, to the circles forming the inside of the wheel, the diameter of the hole in its centre, and the boss surrounding it) must be drawn, as usual, in the same plane; then, let fall a perpendicular C *c*, from the corner of the exterior square, equal to the length of the teeth; and form another series of perspective squares, parallel to those above, at that distance; it will, however, only be necessary to mark the diameters, indicated by those squares, on the line passing through the centre of the wheel, to the centre of the picture; which will be the conjugate diameters of the ellipses; the transverse diameters will be the same as those in the squares, which form the upper surface of the wheel. Diagonals must then be drawn, from the opposite corners of the squares, to find (by their intersection), the perspective centre of the wheel; and also a line *i j*, parallel to A B or C D, through that centre; and another E F, at right angles to it, passing through *k*, to the centre of the picture. Then *i*, F, *j*, E, will be four points, through which the ellipses, bounding the extremities of the teeth of the wheel, must be drawn. Next bisect E F at K; and draw another line I J, parallel to *i j*, which will be the situation of the transverse axis; and E F, the conjugate diameter of the ellipsis; the lines I J and E F, must also be extended each way, for adjusting the situation of the in-

strument. Then, having adjusted all the indexes to their zeros, place the lower sliding bar parallel and perpendicular to the line E F, and the upper one to the line I J, which will be readily done, by placing the two lines produced from the 90 degrees on the opposite sides of the circle Y Y, for that purpose, in contact with the line E F, and the two zeros at right angles thereto on the line I J; the tracer will then be at the point K, in the centre of the intended ellipsis; then screw forwards the lower radial bar, till the tracer coincides with the points, *i* or *j*; next, turn the radial bars, till they are perpendicular to the line E F; and screw forwards the upper radial bar till the tracer coincides with the points E or F, in that line; then turn the radial bars to *i* or *j*, and observe whether the tracer coincides with these points; if not, adjust them accordingly; then turn the radial bars to the point E, and loosen the screw G, which fixes the wheel 1 1, on its axis; and turn the wheel, till the centre of the groove 3, or the commencement of the divisions, coincides with the fiducial edge of the index 7 7, and fix it in that position; then turn the wheel 1 1, together with the radial bars, a quarter round; or till the tracer coincides with the point *j*; and move the dividing plate 2 2, eccentric, along the grooves 3 3, until the fourth part of that circle of divisions upon it, which has been fixed upon, to divide the wheel into the required number of teeth (in this case 360; that number divided by 5, being equal to 72, the number of teeth in the wheel), coincides with the fiducial edge of the index 7 7, which will be the required degree of eccentricity, at that distance from the centre of the picture. The tracer must then be again brought back to the point E; and the nut *c*, on the screw W W, must be unscrewed, equal to the distance E, *e*, or length of the teeth; then the frame A A, will be at liberty to move that distance to draw the lines forming the sides of the teeth.

The instrument being now properly adjusted to draw the lines, which form the faces of the teeth, we shall proceed to give an example thereof. Turn the wheel 1 1, till the commencement of the chosen circle of divisions on the dividing plate 2 2, coincides with the fiducial edge of the index 7 7, and put down the tracer; then turn the dividing plate, 2 divisions, which will be equal to *y z*, or the width of the end of the tooth; then move the wheel A A, eccentric to the right, till the nut *c* stops against the stud *w*; and the line *y x*, will be drawn; forming one side of the face of the tooth; then turn back the dividing plate the two divisions, and the line *x w*, will be drawn, forming the lower end of the face of the tooth; then move the frame A A, to the left, till the nut *d*, on the screw W W, is stopped by the stud *w*, and the line *w z*, will be drawn, which completes the face of the tooth. The tracer and dividing plate being now again in the position where we commenced the operation, the tracer must be raised, and the dividing plate turned five divisions (which will be equal to the breadth of the tooth, and the space between it and the next tooth); and the tracer being put down, a similar process must be performed, to describe the face of the next tooth, and repeated, until we come to the point I, when, as the faces of the teeth are no longer visible, it is only necessary to draw the lines, forming the widths of the teeth, until we arrive at J, when the sides and faces of the teeth will again appear, and must be drawn as before. The radial bars must next be adjusted, till the tracer coincides with the perspective points *o*, P, *q*, *r*, of the square, circumscribing the segments of the ellipsis, which forms the extremities of the bottoms of the teeth; it will also be necessary, at the same time, to move the frame A A, a little in the direction of the line K E (as the transverse axis of this second ellipsis is not in the situation of the former one), and the eccentricity of the divid-

ing plate 2 2, must again be adjusted, so that the tracer coincides with the point *o*, when turned 90°, and the nuts *c* and *d*, on the screw W W, must be also adjusted, to limit the lengths of the lines forming the sides of the bottoms of the teeth. The instrument will now be prepared for delineating the segments marking the spaces between the bottoms of the teeth, and also the basis or sides of the teeth; the dividing plate 2 2, must again be turned, till the commencement of the circle of divisions coincides with the index 7 7; and the tracer will be at the point *r*, of the base of the tooth we first commenced with; the tracer must then be raised, and the dividing plate moved one division and a half towards the left hand, the tracer put down, and the operation proceeded with, as described in drawing the faces of the teeth.

Having now obtained the breadths of the tops and bottoms of the teeth, the curves forming the sides of the ends must next be drawn, which may be done by the instrument; but as the process is more tedious than drawing them by hand, the latter method is to be preferred; the four extremities or corners being already delineated, as above described. Then the frame A A, must be again moved in the direction of the line K L, and the radial bars adjusted, so that the tracer coincides with the points *s t*, *u v*, through which draw the ellipsis, forming the upper side of the interior of the rim of the wheel, and divide it perspectively for the extremities of the arms of the wheel; then adjust the frame A A, and the upper radial bar, so that the tracer coincides with the points *m n*, being the conjugate diameter of the ellipsis, forming the lower angle of the interior of the rim; and draw such parts as can be seen, and also the ellipses *a a*, and *b b*, forming the exterior and interior of the eye of the wheel, as well as part of another *d d*, denoting the depth of the eye must also be delineated. The instrument being then removed,

the arms may be drawn, which will complete the delineation of the wheel in perspective.

The eccentricity of the dividing plate 2 2, of the instrument, may be adjusted to divide ellipses perspectively, in any given situation, by means of the scale and nonius in the groove 3, by the following rules: thus, let there be given the number on the dividing plate 2 2, 660; the radius of the conjugate diameter of the ellipsis 2,000, or, which is the same thing, 2 inches; the eccentricity of the dividing plate 118 (as marked by the nonius 3); and the distance of the centre of the ellipsis from the vanishing point, or centre of the picture, 10 inches; then to find the eccentricity of the dividing plate for any other distance of the vanishing point, or conjugate radius of the ellipsis should both vary, two operations will be necessary; the one by inverse, and the other by direct proportion, and which will be most readily performed by means of the sliding rule, as in the following example:

Suppose the distance of the vanishing point, from the centre of the ellipsis, to be 20 inches; the radius of the conjugate diameter 1,000, or 1 inch, and the number on the dividing plate 660; what will be the eccentricity of the dividing plate?

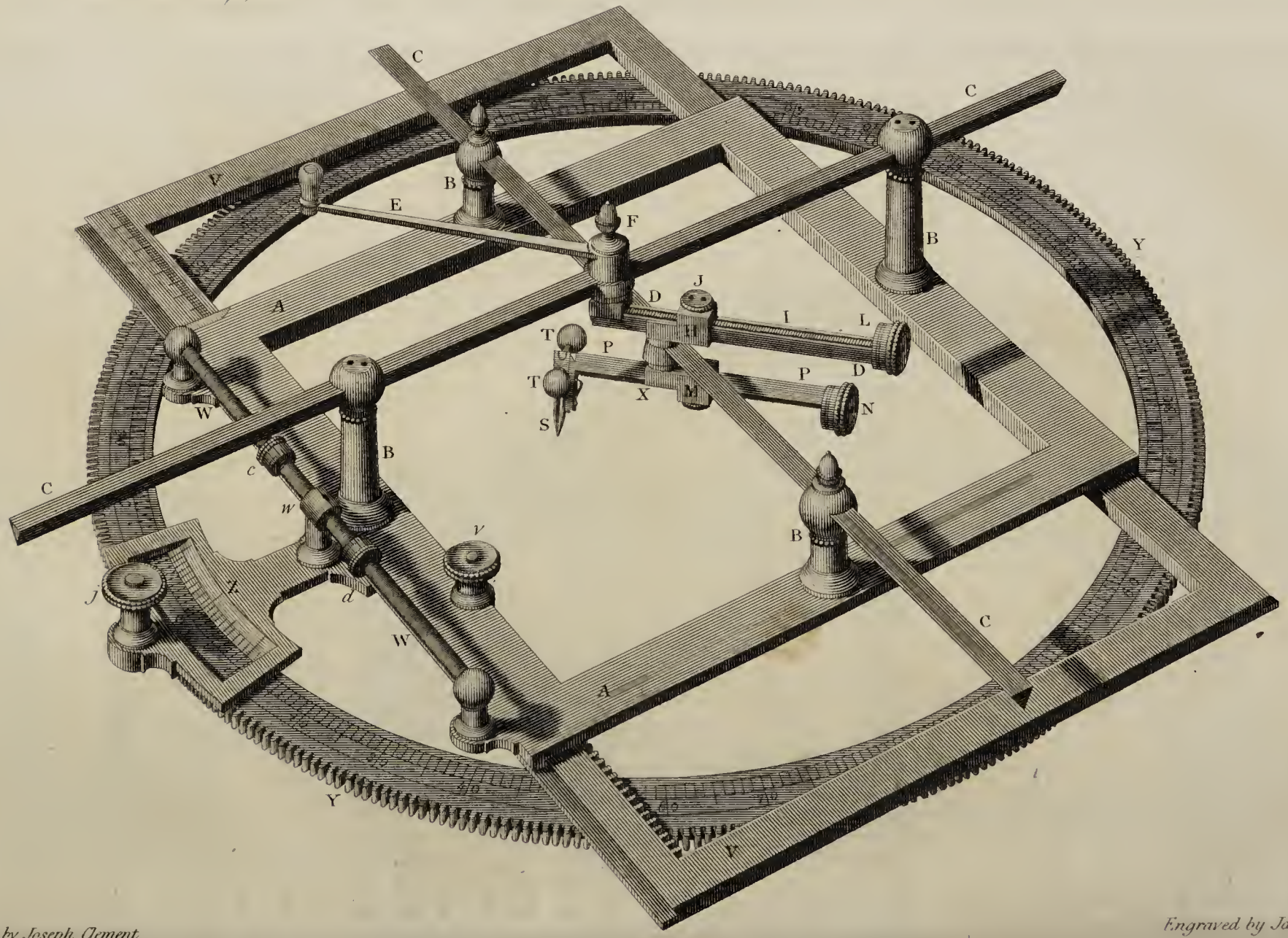
First, as 10 inches, the distance of the vanishing point from the centre of the ellipsis, is to 118, the eccentricity of the dividing plate, so is 20 inches, the distance of the vanishing point given, to 59, the eccentricity required.

Then, as 2,000, or 2 inches, the conjugate radius, is to 59, the eccentricity of the dividing plate, so is 1,000, or 1 inch, the conjugate radius, to 29·5, the eccentricity required. It is obvious, that should only one of the two circumstances vary, one operation will be sufficient, instead of two, as in the foregoing examples.

Should, however, any other circle of divisions on the plate 2 2, be chosen, instead of that divided into 660,

Mr. Joseph Clements's Instrument for Drawing Ellipses, &c.

Plate. 17.




Drawn by Joseph Clement.

Engraved by James Davis.

# Mr. Joseph Clement's Instrument for Drawing Ellipses, &c.



Fig. 2.

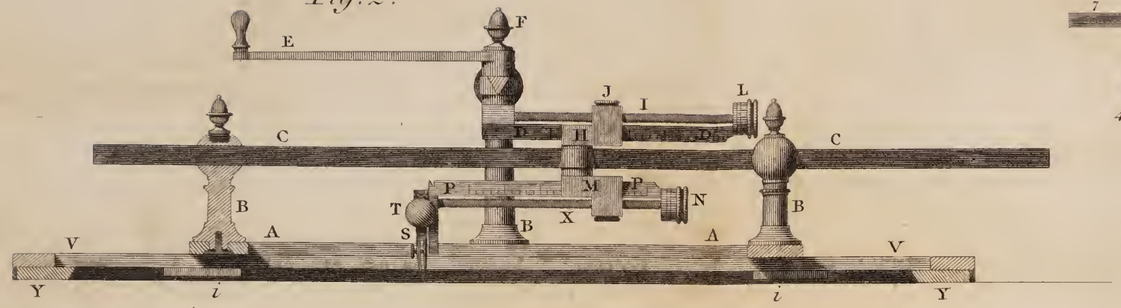



Fig. 4.

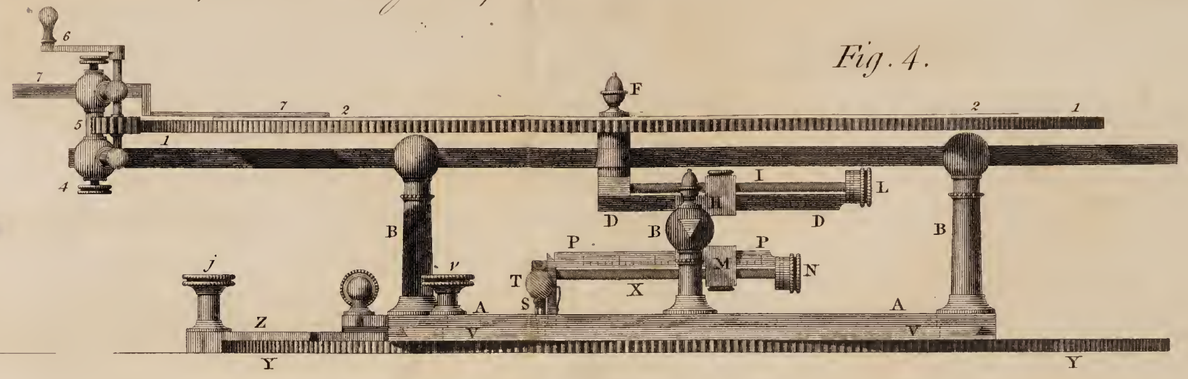



Fig. 1.

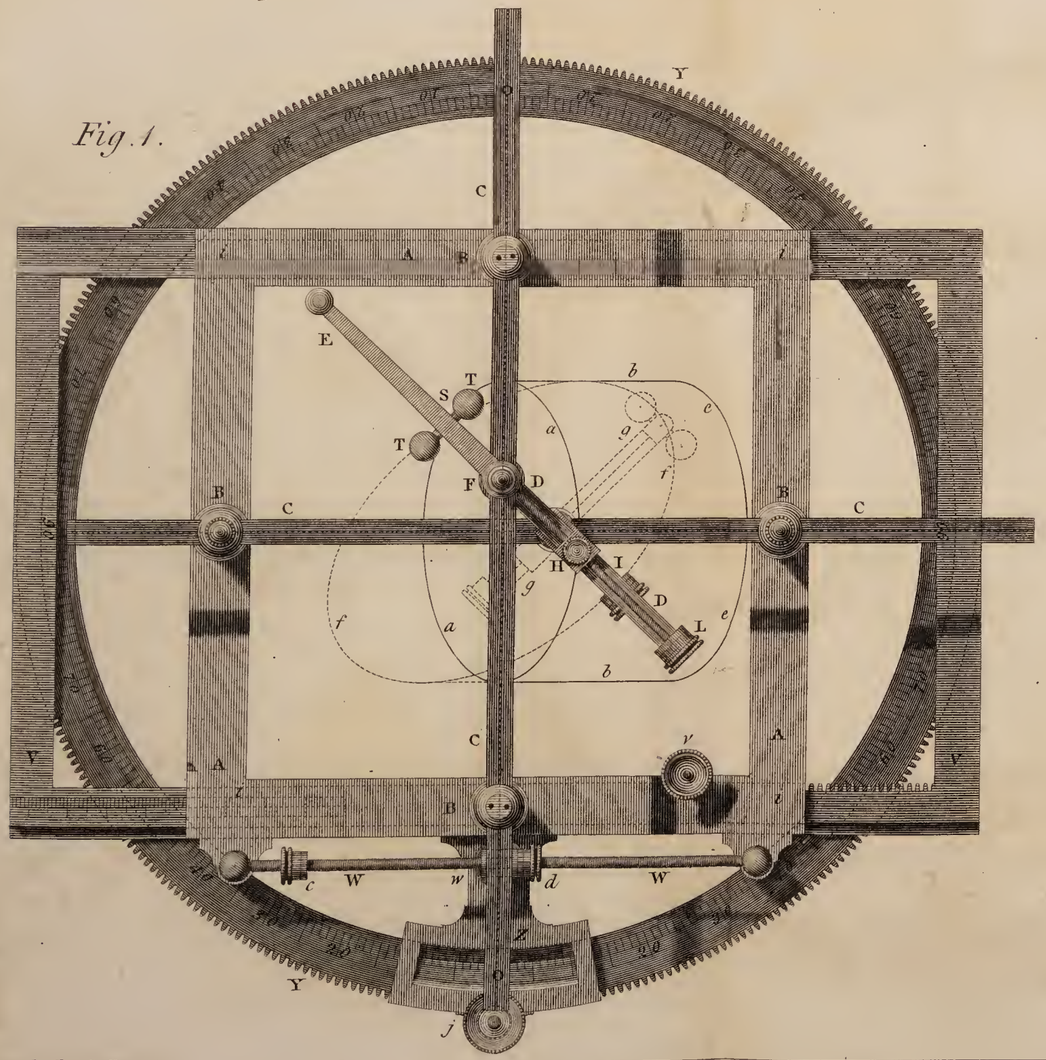
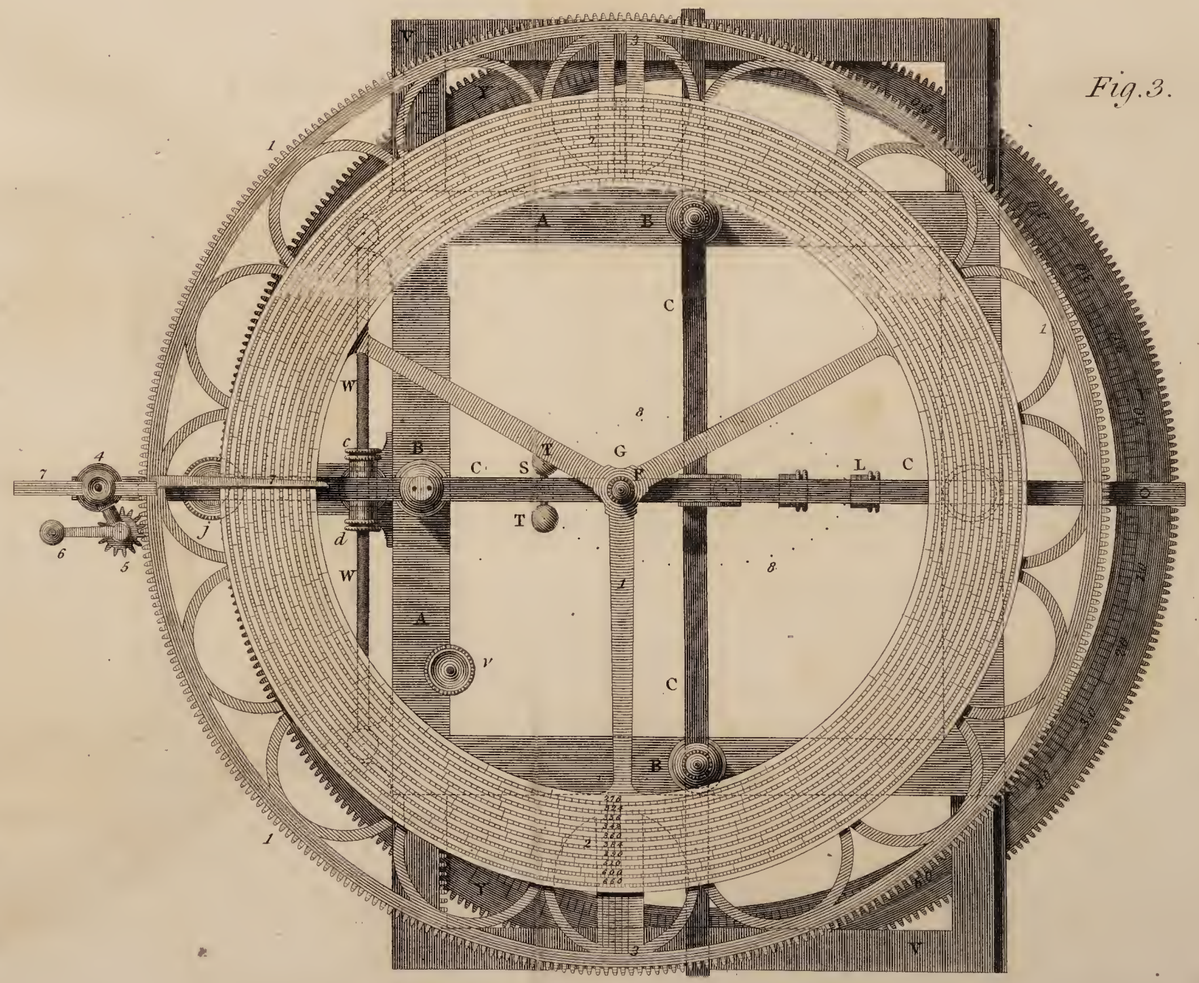



Fig. 3.




Drawn by Joseph Clement.

Engraved by James Davis.

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 Inches

# Mr. Joseph Clement's Instrument for Drawing Ellipses, &c.

Pl. 19.

Fig. 1.

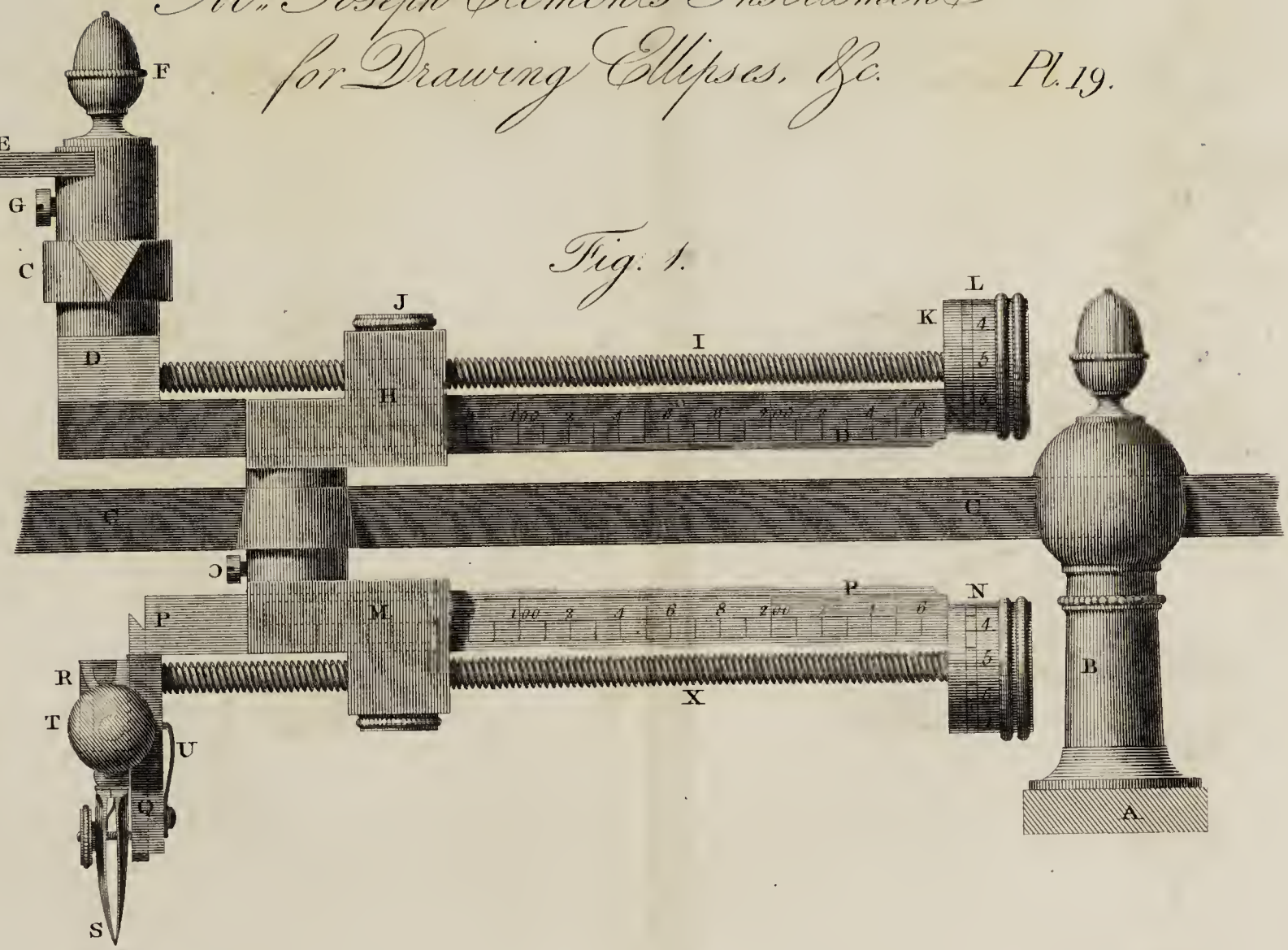



Fig. 2.

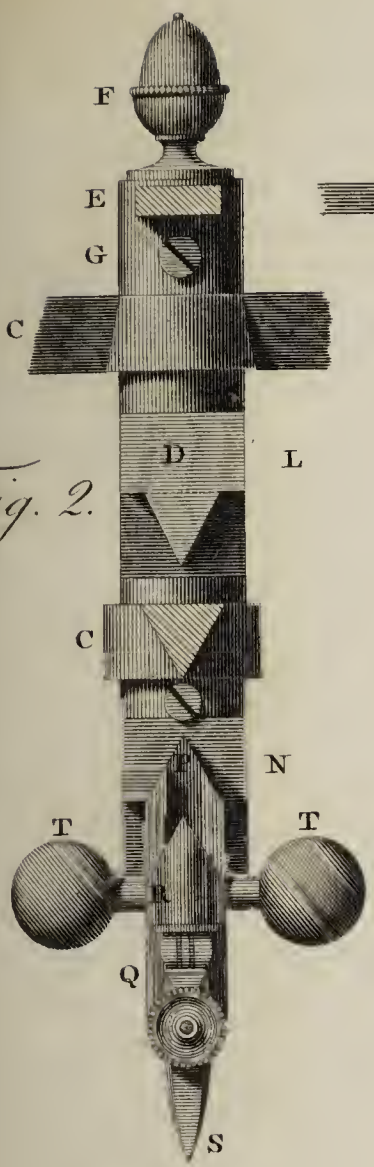



Fig. 3.

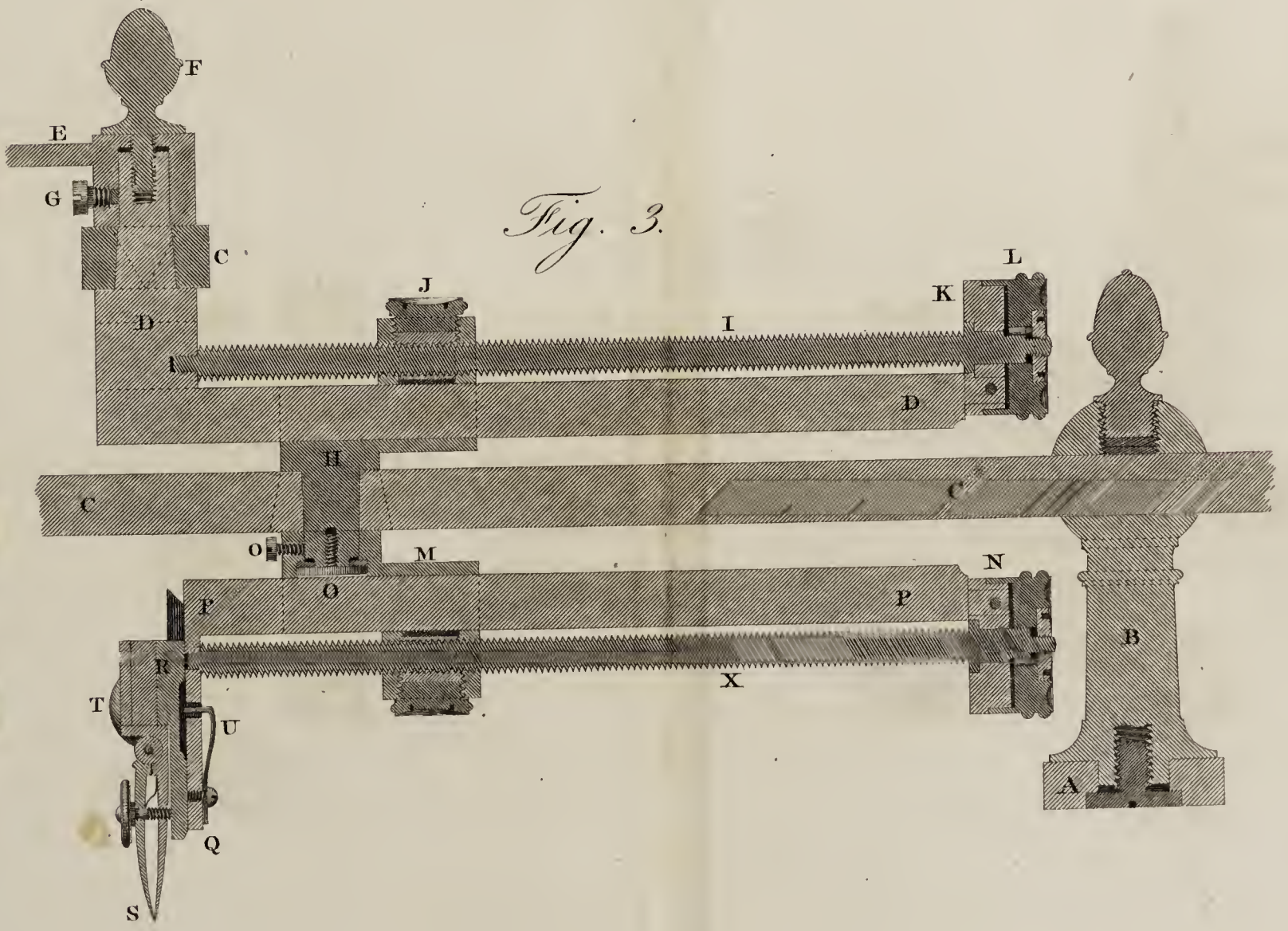



Fig. 4.

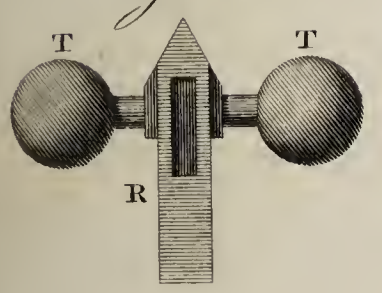



Fig. 5.

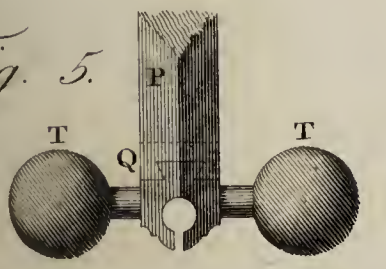



Fig. 6.

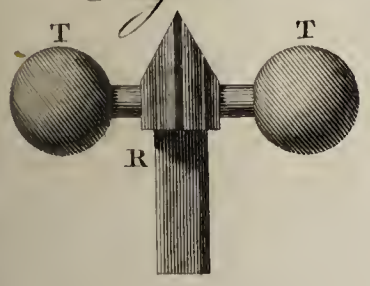



Fig. 7.

Drawn by Joseph Clement.

Engraved by James Davis.

# Examples shewing the use of Mr. J. Clement's Instrument

Fig. 1.

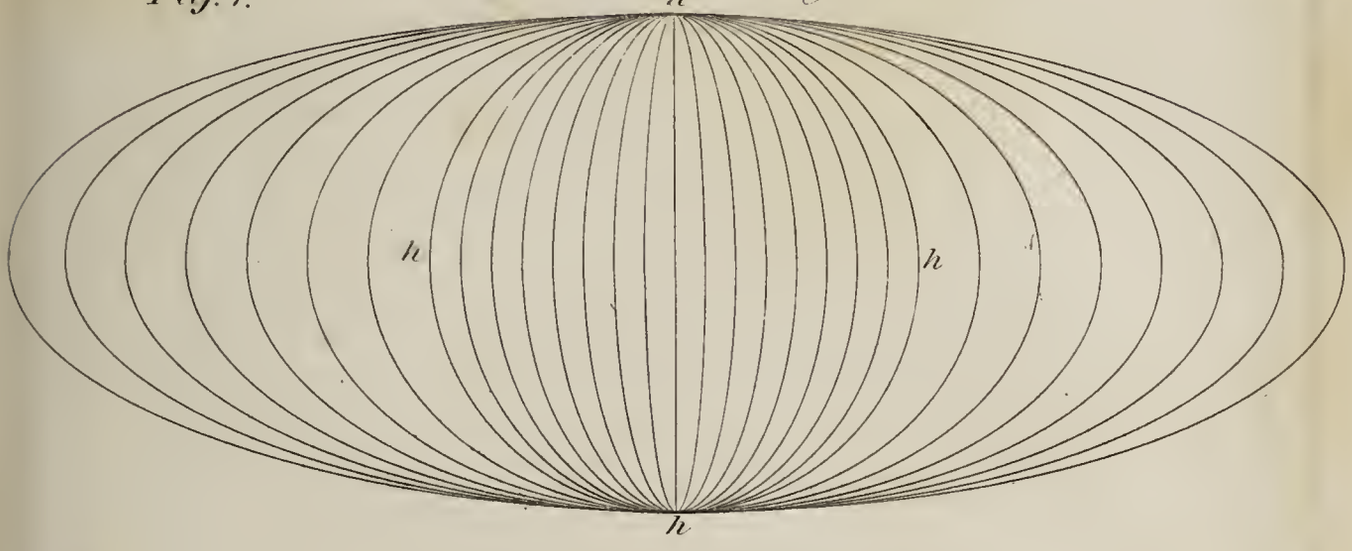



Fig. 4.

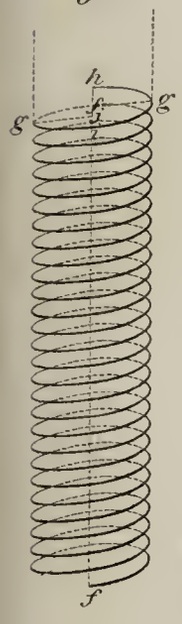



Fig. 2.

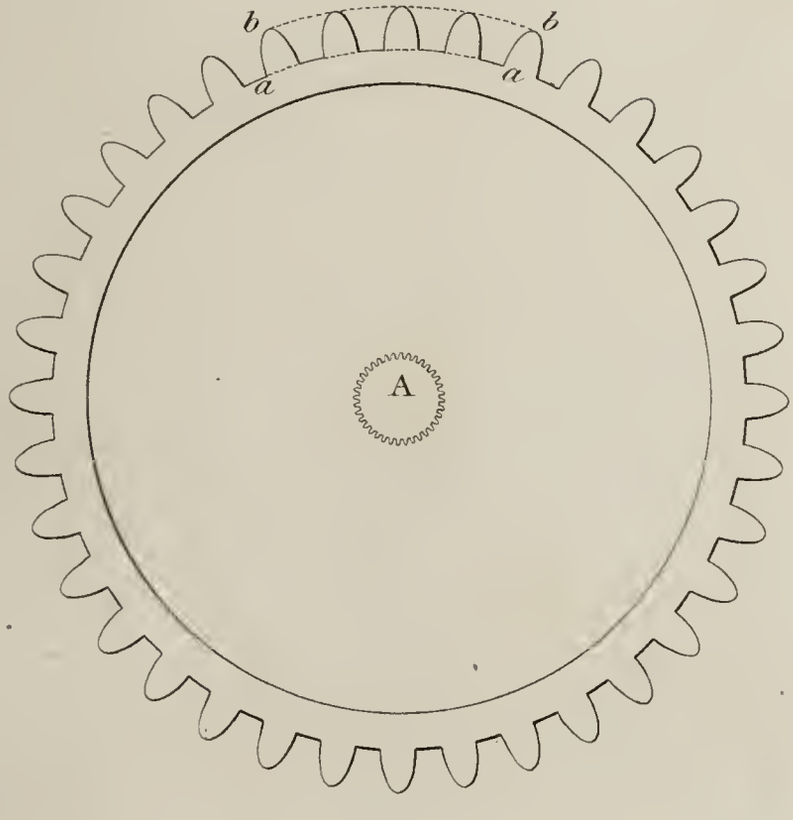



Fig. 6.

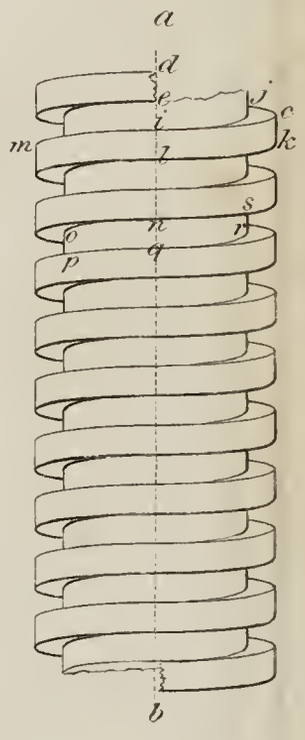



Fig. 5.

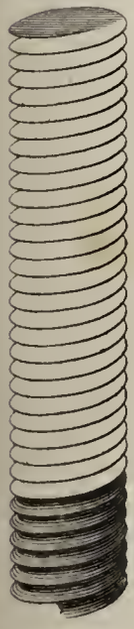


Fig. 7.

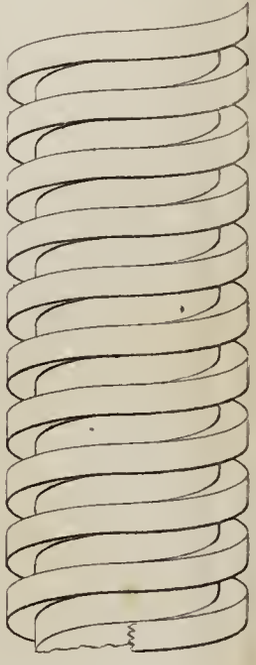
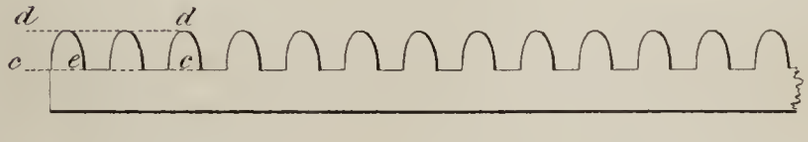


Fig. 3.




J. Clement & J. Davis Sculp.t

*Examples shewing the use of Mr. J. Clement's Instrument.*

Plate. 21.

*Fig. 1.*

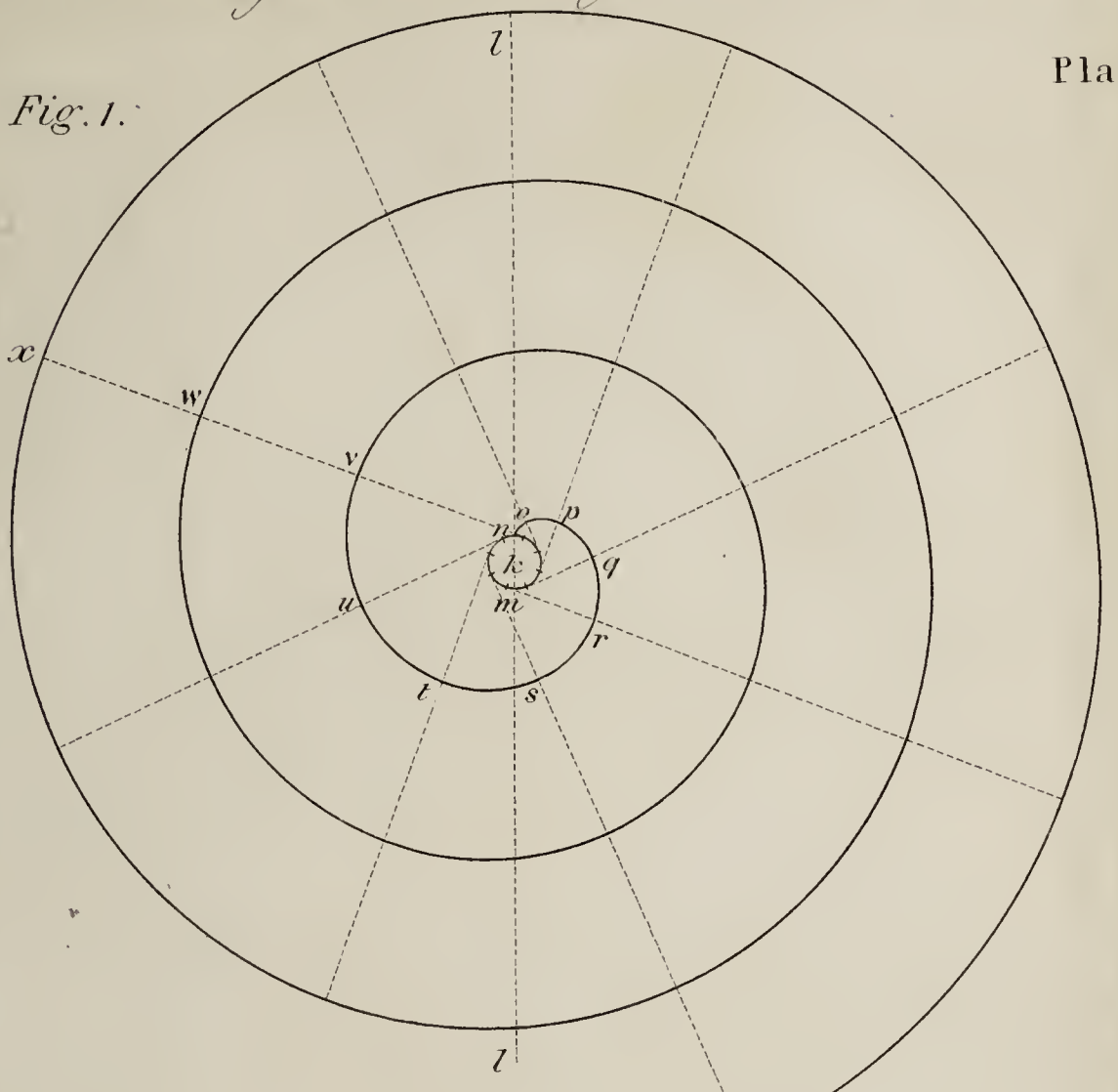
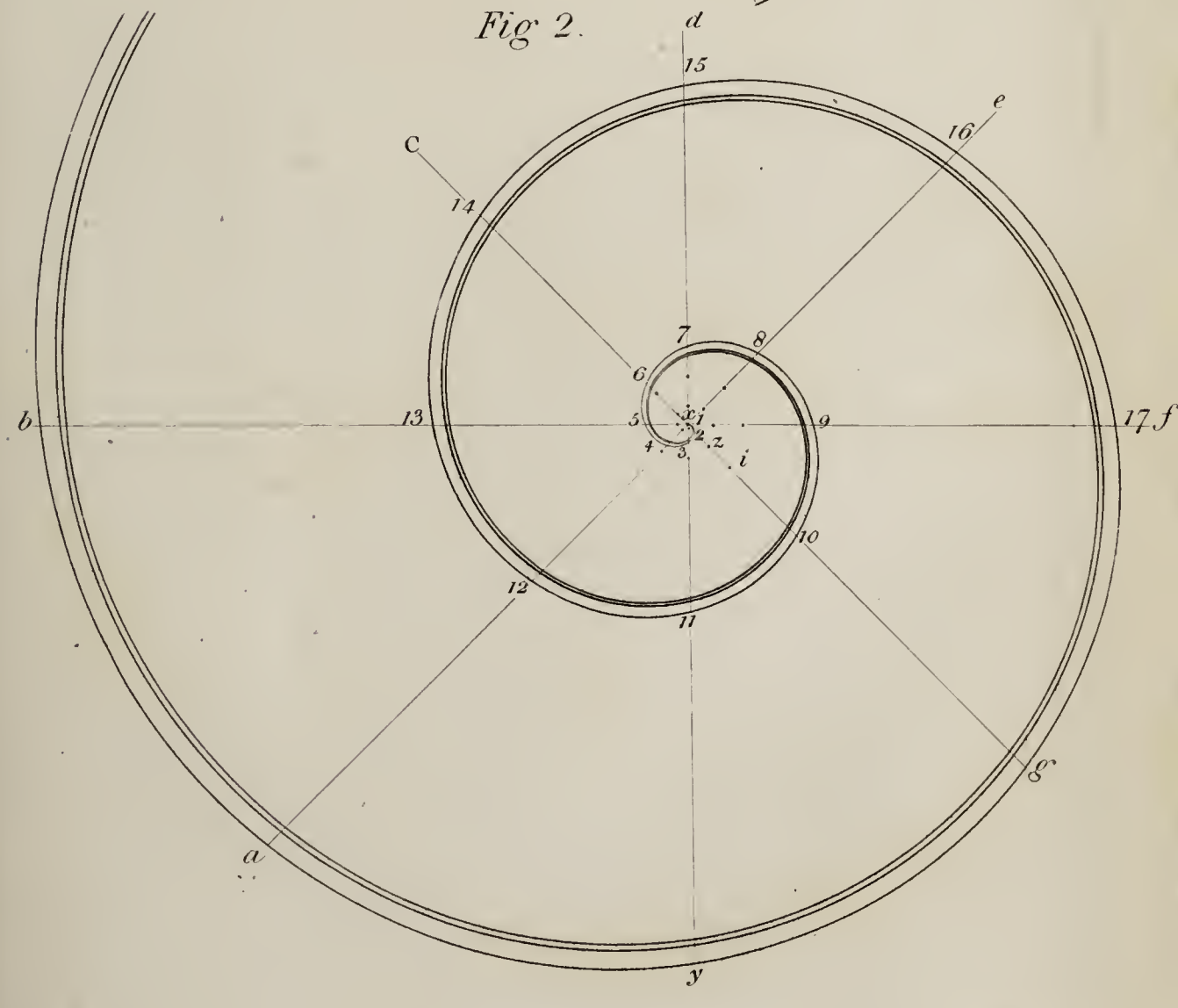



*Fig. 2.*




J. Clement & J. Davis Scu

# Examples shewing the use of Mr. J. Clement's Instrument.

*Fig. 1.*

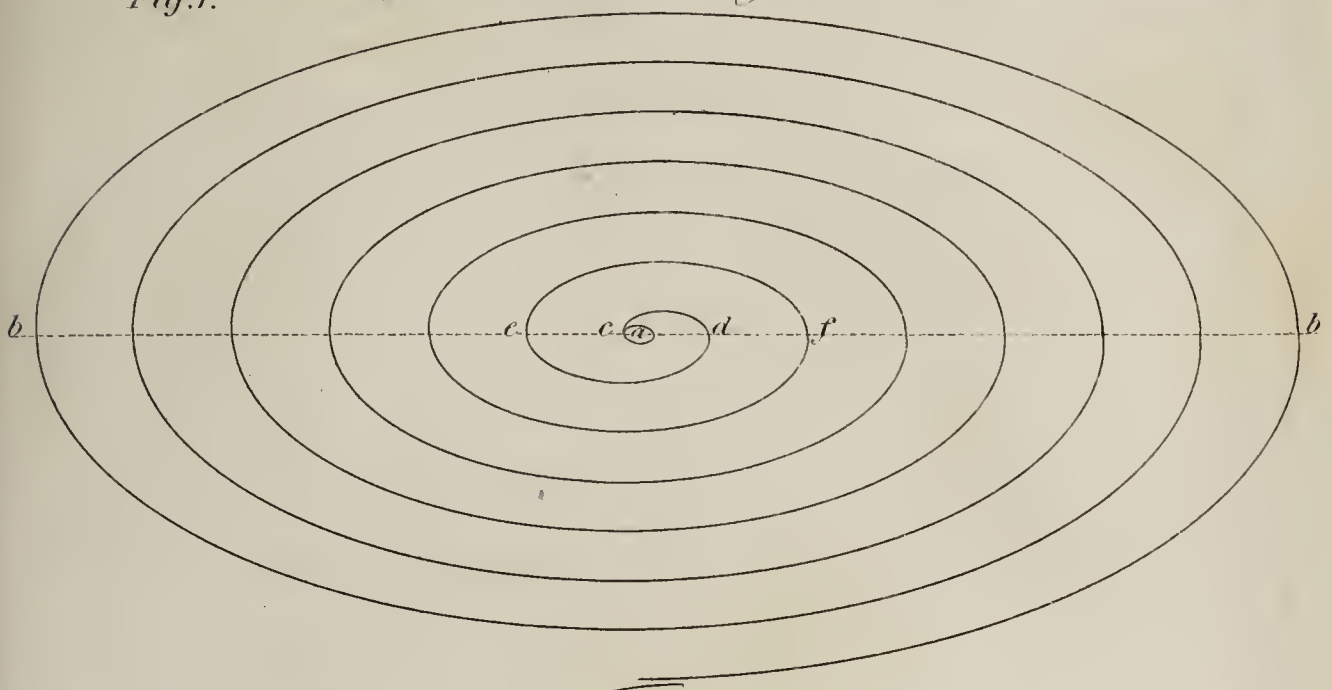
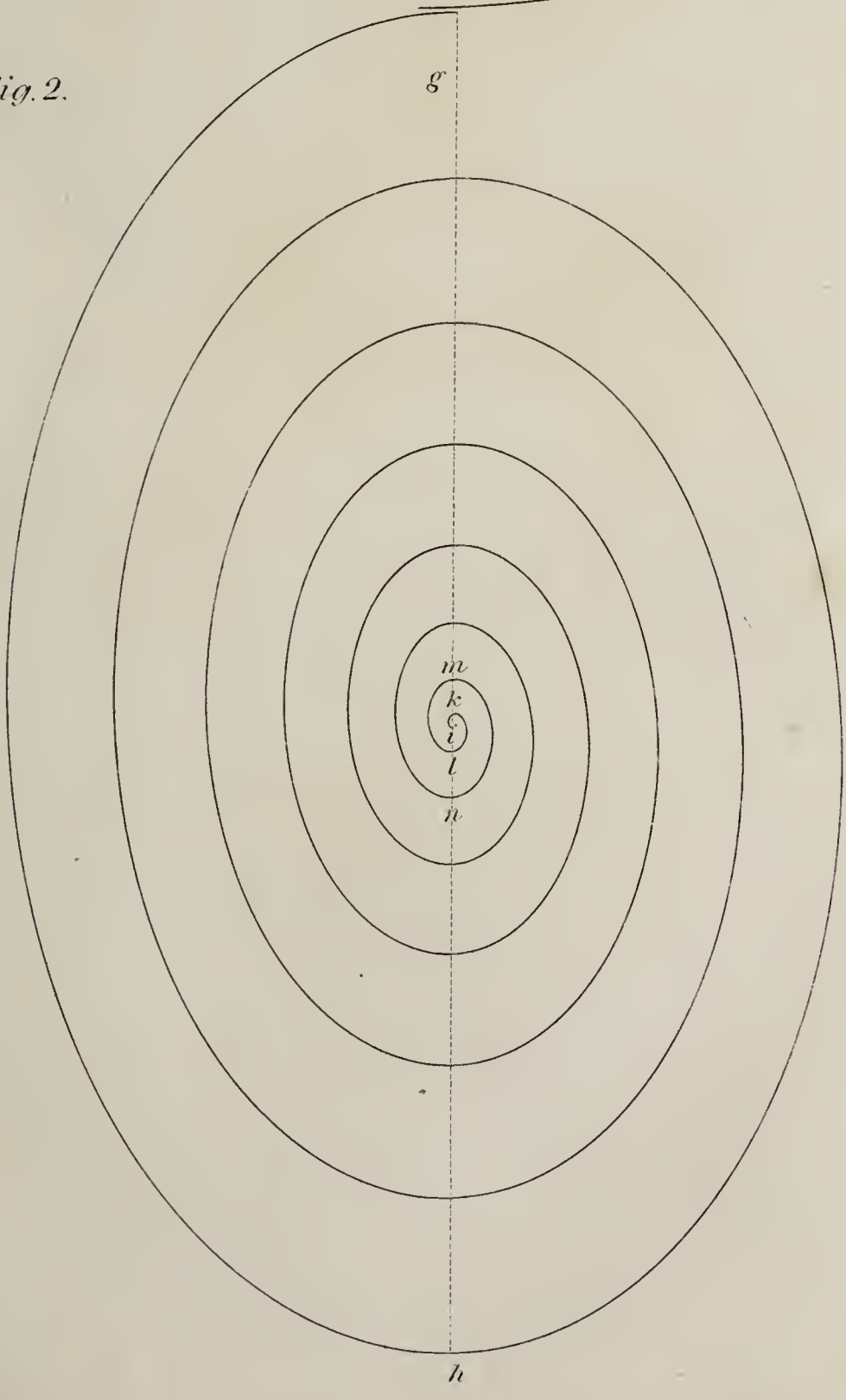



*Fig. 2.*




J. Clement & J. Davis, Sculp.t

# Geometrical Projections of the Sphere
## by Mr. J. Clement's Elliptical Instrument.

Fig: 1.

Plate. 23.

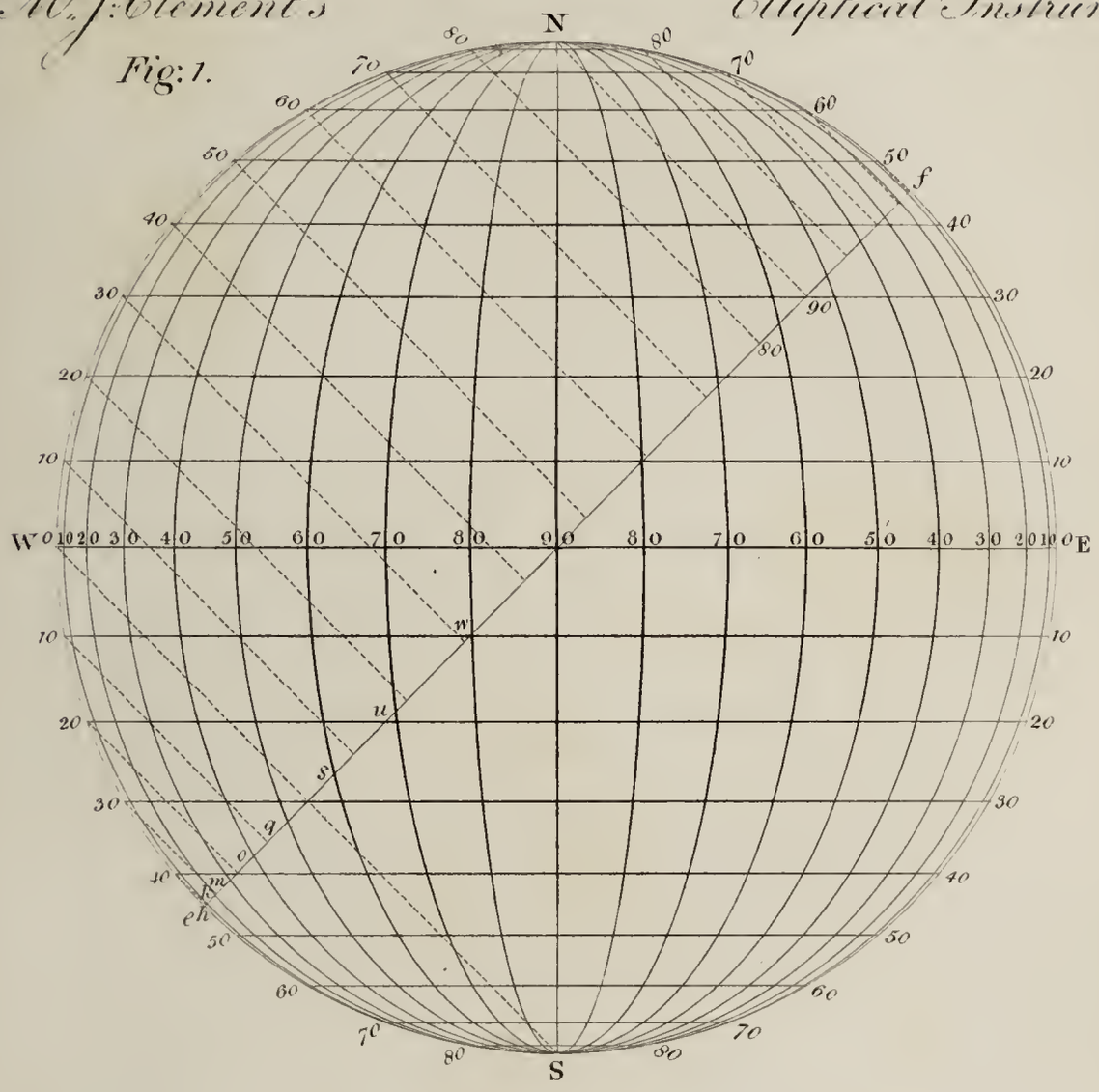
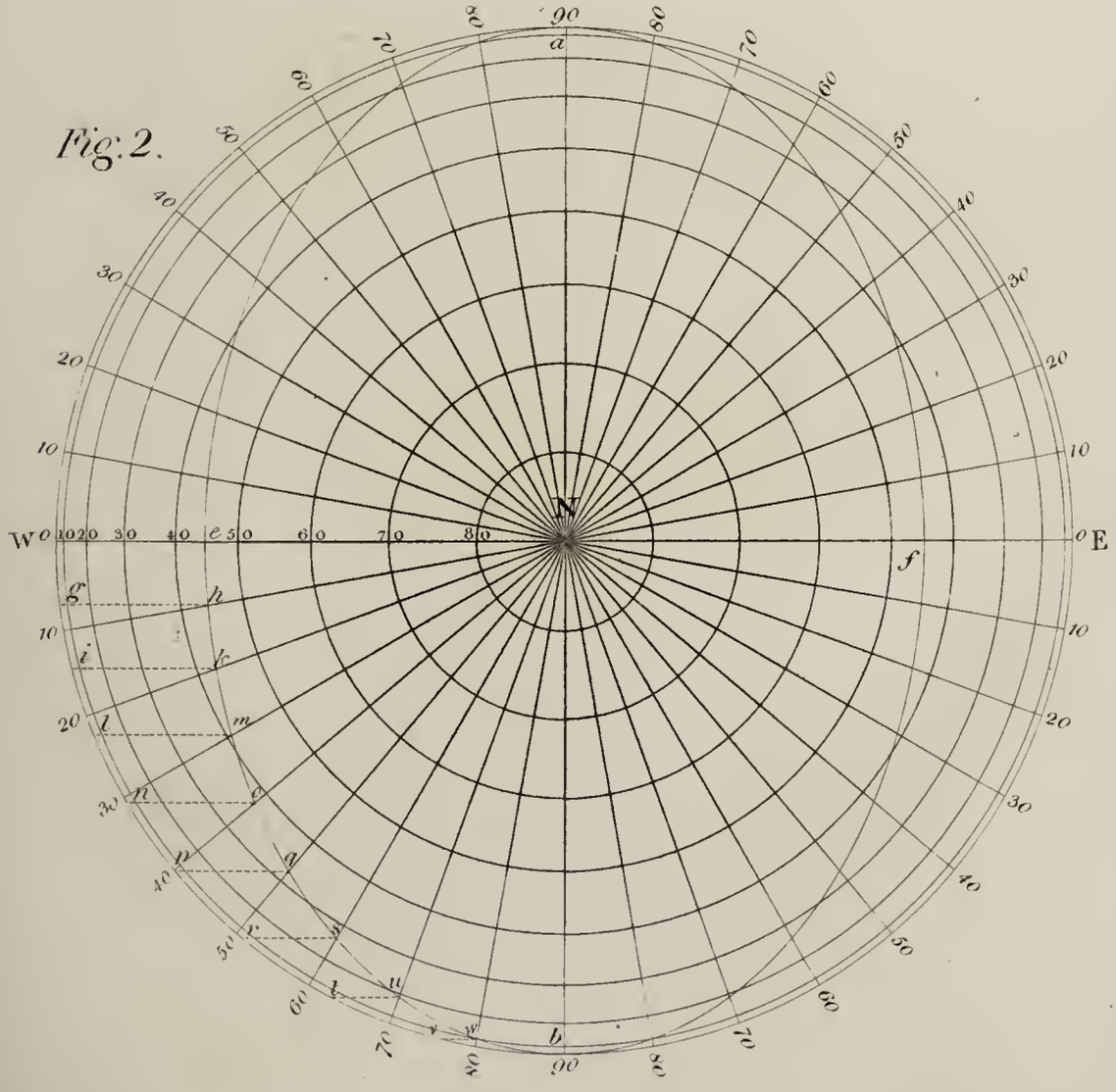



Fig: 2.




J. Clement & J. Davis, Sc

# Geometrical Projections of the Sphere

by M.r J. Clements's Elliptical Instrument

Plate. 24

*Fig: 1.*

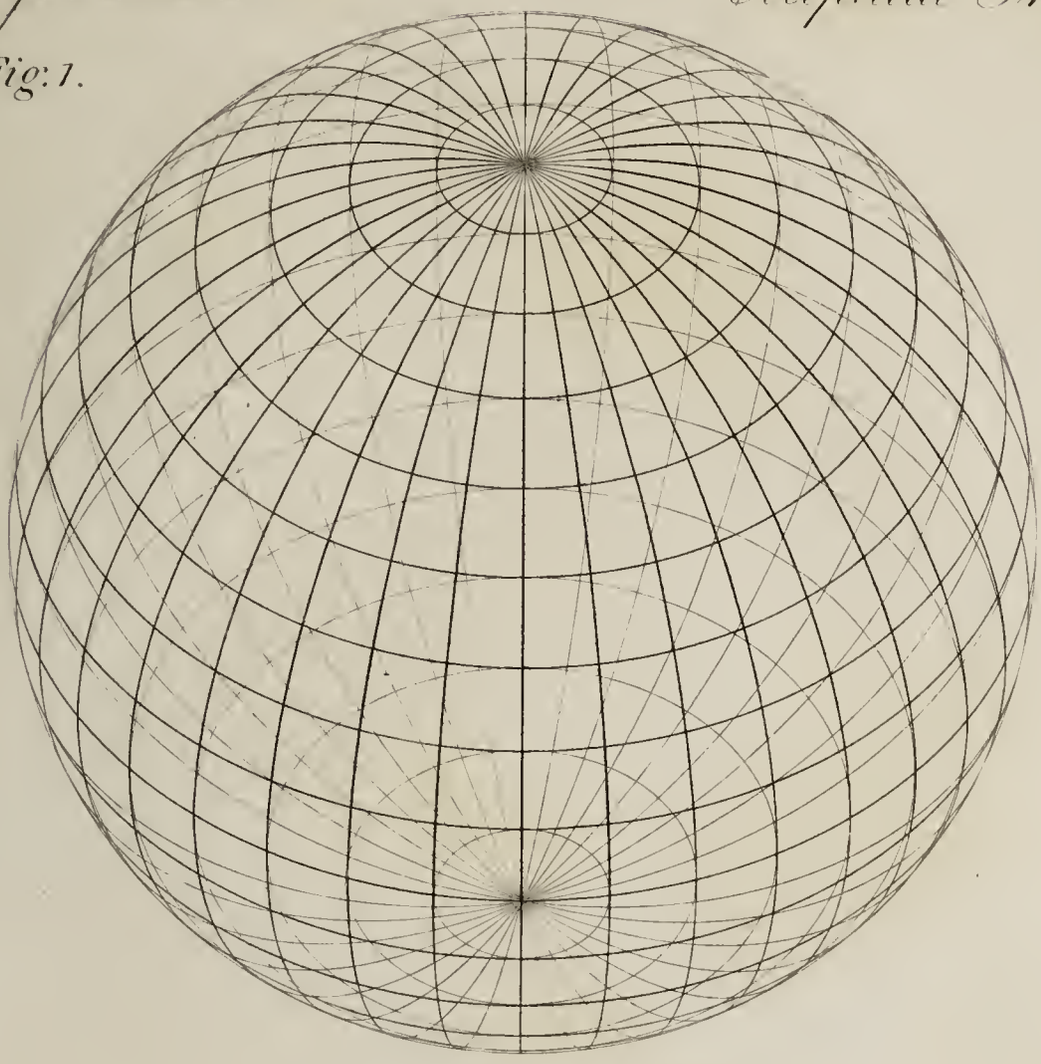
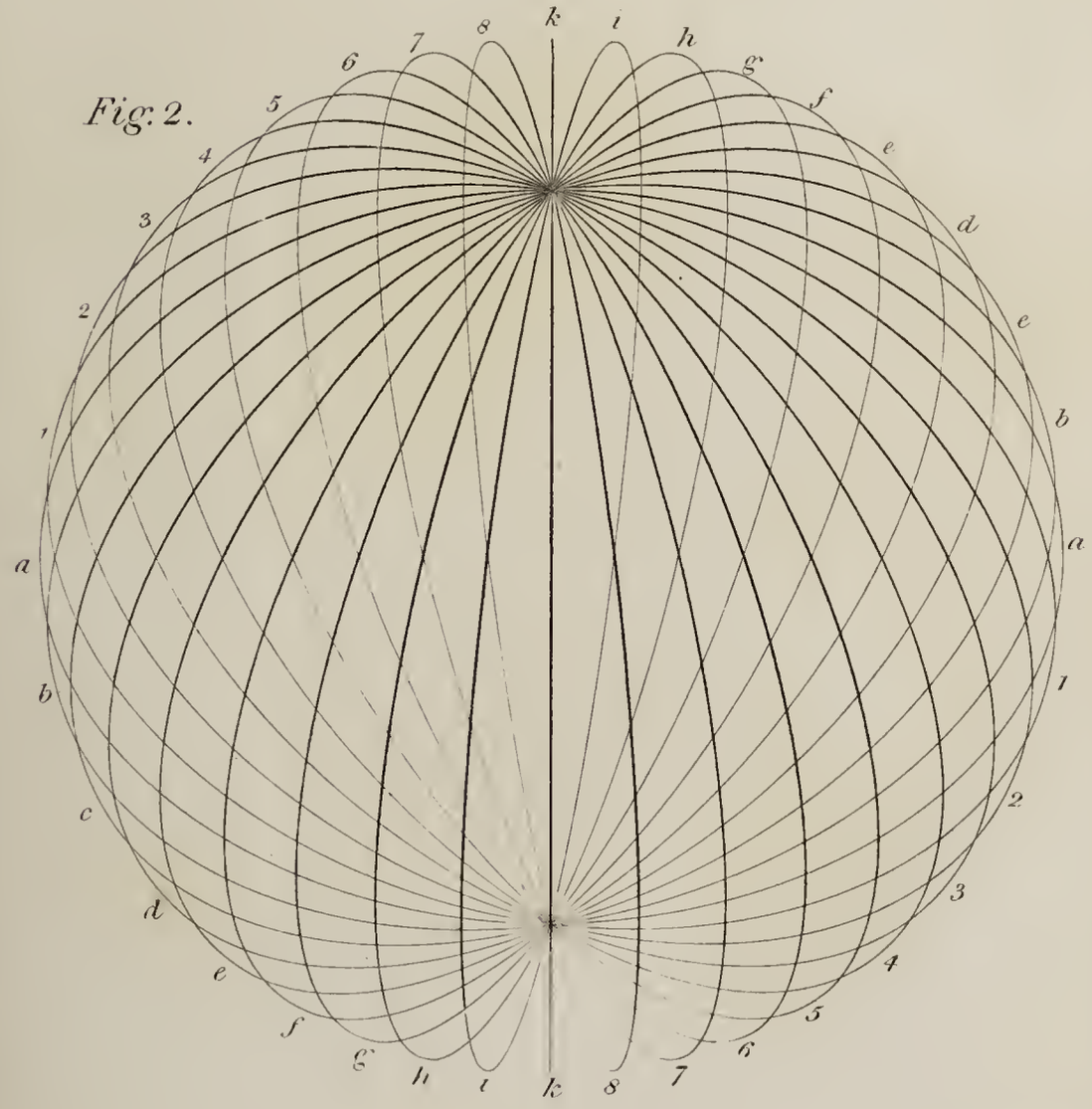
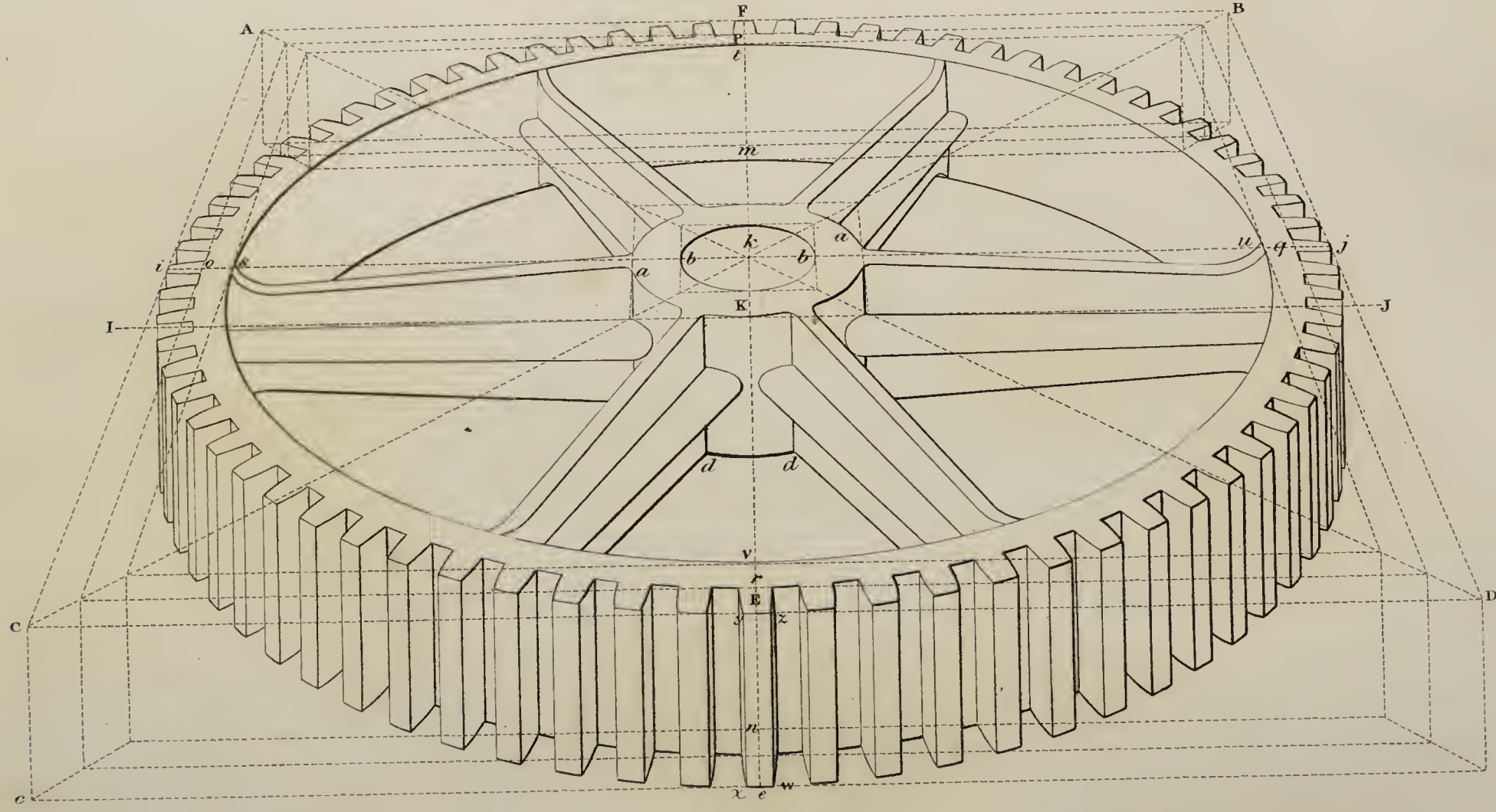


*Fig: 2.*




J. Clement & J. Davis Sculp

# An Example of the use of Mr. J. Clement's Instrument.




J. Clement & J. Davis Sculp.

(which is the circle of the greatest radius on the plate), that circle would bear the same proportion to its eccentricity, as the radius of the circle of 660, does to 118, the eccentricity of the dividing plate; or, as the radius of 600, or the next greatest circle of divisions, does to the eccentricity 115; and so also will the remaining circles upon the plate, bear the same relative proportion to its eccentricity; as shown by the following table.

As the number 660 is to 118, the eccentricity of the

| | | | |
|---|---|---|---|
| So is | 600 | to | 115 |
| | 510 | to | 112 |
| | 390 | to | 109 |
| | 384 | to | 106 |
| | 360 | to | 103 |
| | 342 | to | 100 |
| | 336 | to | 97 |
| | 324 | to | 94 |
| and | 376 | to | 91 |

[dividing plate

The uses of the instrument are however by no means confined to the few examples here given; but it will be found of the utmost advantage in mechanical and architectural drawing in general; and particularly from the great facility it affords of delineating the different curves, in the various situations where they are required; a property which no other instrument, hitherto invented, possesses in an equal degree.

# ADDRESS.

AN

# ADDRESS

DELIVERED ON THE 26TH OF MAY, 1818,

AT THE

# Annual Distribution,

BY THE HANDS OF

*His Royal Highness the*

DUKE OF SUSSEX, &c. &c. PRESIDENT,

OF THE

*REWARDS*

ADJUDGED BY THE

SOCIETY FOR THE ENCOURAGEMENT OF

*ARTS, MANUFACTURES, AND COMMERCE,*

BY

ARTHUR AIKIN, F. L. S., COR. ACAD. DIJ.,

SECRETARY.

# ADDRESS,

*&c.*

AMONG the modern Chinese, as among the ancient Egyptians, the principal annual festival is in honour of the souls of their ancestors. The members of each family, repairing to those places in which are deposited the remains of their predecessors, and about which their spirits are deemed still fondly to linger, offer the oblations of their filial gratitude, flowers, and fruits, and rice; and pay those soothing, but unburthensome attentions by which the souls of the departed are supposed to be well pleased.

In somewhat of a similar spirit the members of the Society for the Encouragement of Arts, Manufactures, and Commerce, are on this day assembled to hold their annual commemoration of those worthies to whose meritorious exertions this Institution owes its origin. Their names will ever be held by us in merited respect; and, in obedience to the dictates of natural gratitude, we have made the performance of this duty the introduction to that which is at once the end and crown of our annual labours, the distribution of those honorary and pecuniary rewards which have been voted by the Society in the course of the present Session.

It is now 64 years since Mr. Wm. Shipley, after encountering the difficulties which attend the establishment

of every new institution, arising from the lukewarmness of some, and the extravagantly sanguine expectations of others, succeeded in founding a society, comprehending in its ample range no meaner objects than the encouragement of the Arts, Manufactures, and Commerce, of the British Empire.

The Lords Folkestone and Romney, who at that time wore the hereditary honours of their respective families, contributed their powerful influence and support. The Rev. Dr. Stephen Hales, author of the Treatise on Vegetable Statics, and of various inventions calculated for the benefit of society; Mr. Powel of Brecknock, Dr. Garden of Philadelphia, Sir C. Whitworth, Dr. Russell, and Dr. Franklin were eminently serviceable in various ways, by their personal attendance, by their correspondence, by their zeal in procuring new members, and by the general weight of their characters to the rising institution. Every successive meeting added to the number of subscribers, and in the course of a few years it had associated together eminent persons from every party in the country, who, how much soever they might differ on other points, most cordially concurred in the promotion of a plan, the importance of which admitted of no dispute, and of which the results promised to be so extensively and impartially useful.

A remarkable difference between the literary and scientific institutions of England, when compared with those of the continent of Europe, is, that the former have arisen from, and have continued to be supported by, the voluntary exertions of individuals, liberal of their time, their talents, and their money, for the public good; whereas the latter have been, for the most part, produced under the fostering influence of their respective governments, and

continue to derive from the state most of the funds necessary for their support. Hence the latter may be, and, in some instances no doubt are, the result only of a wise and liberal feeling in the sovereign or his ministers, and the situations of honour or of emolument attached to them, falling necessarily under the patronage of the government, are bestowed too often for reasons but slightly connected with the ostensible objects of such institutions. In this country, on the other hand, most of our establishments for the communication of knowledge, general, professional, and scientific, are the result of voluntary effort, and depend for their pecuniary resources almost wholly on the annual subscriptions of their members. Hence they cannot well arise before the public mind is sufficiently enlightened to afford them an effectual support; and the necessary condition of their very existence is unwearied and well-directed exertion. In proportion as the zeal of the members becomes languid, as they fall into favouritism or misemploy their funds, their subscriptions decline, and are soon absorbed by some other society more wisely or more actively zealous. Such being the state of scientific institutions in this country, that society whose constitution is the most liberal, and which therefore can incline itself, with the most vigorous pliability, to the ever-varying circumstances induced by the temper of the public mind, and the continually-accelerating progress of knowledge, stands the fairest chance for durable prosperity.

It is therefore no light obligation that we owe to the wisdom of the founders of this Institution, who, in proposing to themselves and to their successors so vast a range as the commerce, the arts, the agriculture, and the manufactures of the country, forbore to circumscribe it within the bounds even of the most liberal charter that the munificence of the sovereign could bestow. Innu-

merable are the occasions in a Society so numerous and therefore so miscellaneous as this, in which differences of opinion arise, that, under the management of a close corporation, might soon degenerate into that most acrimonious form of party controversy, in which measures proposed are estimated, not by their intrinsic fitness or advantage, but by the party connexions of the individuals who support them. From this most deadly bane, we have hitherto escaped by the salutary practice of making every measure originate in the general body of the Society, and of referring to the same body, for final confirmation, every report of every committee. The constitution of our committees, also, which are open to each member of the Society, gives an additional security for the equity and justice of our proceedings. Those subjects which are generally the most interesting, of course induce the fullest attendance; the quantity or species of which varies according to the nature of the subject under consideration. A proposed improvement in Time-keepers, for example, insures to us the voluntary attendance of a greater or less proportion of those ingenious artists in this department who belong to the Society: some may attend from curiosity, some from the hope of obtaining useful information, some from a spirit of rivalry, some from a desire that the reputation of the Institution of which they form a part, may not be committed by rewarding what is worthless or well known, or by rejecting a valuable and original invention. Whatever be the motive, a sufficient number of competent judges is thus assembled, whose opinions will necessarily and properly exert a due influence over the rest of the Committee. An improvement in Mill Work, in the Steam Engine, in the Printing Press, in the Life-boat, in the Theodolite, will, in like manner, secure to us the attendance of those who are the best qualified to lead the opinions of the rest on these particular subjects; the general result of

which is, that each committee is sufficiently and appropriately filled by the mere spontaneous attendance of those who are the most interested in the particular subject of discussion, without imposing the necessity of attendance on any one, except the chairman; and, there being two of these officers to every committee, it rarely indeed happens that one at least is not in readiness to preside.

There are three circumstances which may safely be assumed as indicative of the state of a Society, whether it is advancing, is become stationary, or has begun to decline. These are, the number of its efficient members, the degree of attendance on the committees and meetings of the Society, and the quantity and importance of the subjects which are offered for reward. In all these particulars, I am happy in having it in my power thus publicly to declare, that the situation of this Society is highly satisfactory.

Two hundred new members have been inscribed on our books since the last anniversary. In the mean time we have lost some by death, and probably others by removal of residence and change of circumstances, the number of whom cannot be accurately ascertained: after, however, the most liberal deductions have been made on these accounts, there will remain a clear and considerable increase on the whole.

The necessity which has occurred during the present Session of providing additional accommodation in our hall of meeting, and complaints, well-founded and often repeated, of the thronged state of our committee room, are sufficient evidence of the zealous and assiduous attendance of the members. Nor is this the result of occasional and casual curiosity, since the weekly issue of notices of committees to the members alone, which some

years ago scarcely amounted to 50, falls now very little short of 200.

With regard to the value of the communications in recompense of which the rewards of the Society are this day about to be conferred, it may seem invidious to compare them with those of former years; yet I cannot avoid stating, that that volume will not be found the least important of the Society's Transactions, which shall contain the details of Mr. Bradshaw's successful and spirited culture of Peat Moss; of Mr. Bowden's method of preventing and curing the Dry Rot in Ship Timber; of Lieut. Shuldham's method of Ballasting Swift Sailing Vessels; and of Mr. Clement's beautiful Machine for describing Ellipses; not to mention the effectual aid offered to the seamen in the accidents and perils to which his occupation exposes him, by the Life Preserver of Mr. Grant, and the Night Life Buoy of Mr. Cook.

Without ascribing to the efforts of this Society a greater influence on the public welfare than they fairly deserve, it is, however, gratifying to reflect that the time of its duration is strictly coincident with that in the course of which all those vast discoveries in the mechanical, chemical, and agricultural arts have arisen, by which the present generation is so eminently distinguished from all preceding ones. To lay before you in detail, and in all their bearings on each other, this immense accumulation of knowledge and of power, is a subject too extensive for our prescribed time, and far too weighty for the abilities of him who has now the honour of addressing you; yet I cannot prevail on myself wholly to forego the attempt to offer to your notice some sketch, however slight, of the principal obligations which we owe to our immediate predecessors, some of whom still linger on the western horizon

of life, that we may hence be inspired with the honourable ambition of proving ourselves the worthy descendants of those who have multiplied to so vast an extent the resources of human ingenuity.

When the civil commotions and foreign wars which for sixty years had agitated the whole British nation, were finally settled by the result of the insurrection of 1745; and the present Royal Family, after an arduous struggle, was at length firmly established on the throne, the minds of men naturally began to turn themselves to those arts of peace which the uncertainty of public affairs, and the more stimulant interest of political party, had consigned to a long neglect.

The situation of the country with respect to the arts, the manufactures, and all those things in which the public wealth of the community consists, was at that time considerably inferior to that of Holland, the Netherlands, France, and some of the Italian states.

The internal communication between one place and another, was carried on partly by circuitous coasting voyages, partly by rivers obstructed by shoals during the Summer season, and swelled into formidable torrents by the Winter rains, and partly by roads, so ill constructed, and in such a state of neglect, that the cheapest and most expeditious way of transporting commodities along them, was on the backs of pack-horses.

A considerable proportion of the entire surface of the land was occupied by uncultivated wastes; the drainage of the fens of Cambridgeshire, Lincolnshire, Huntingdonshire, and Norfolk, as well as those of Somerset and Gloucestershire, at no former period very perfect, had

fallen at this time into great decay. The system of agriculture was rude and wasteful, and no attention had been paid to improving our breeds of domestic animals, except of the horse.

A large proportion of our manufactures were literally so, being made by hand: the only first movers of the common machinery which we possessed were, the elements of water and of wind, and the living strength of men and of animals, excepting in a few places where the Steam Engine of Savary and of Newcomen, a machine of rude and imperfect construction, and of little power, was employed in raising water.

The smelting and conversion of the ores of iron and of our other metals was performed almost wholly by means of charcoal, by which not only was their cost enhanced, but the quantity produced was very limited, in consequence of the diminished extent and impoverishment of our woods and forests.

No manufacture of pottery, but of the very coarsest kind, existed: vessels of wood, of pewter, and even of leather, formed the principal part of the household and table utensils of genteel and opulent families; our porcelain was imported from China and Japan, from Dresden and Paris; and was an article rather of luxury than of convenience.

The principal part of our linen was from the looms of Germany and Holland, and of our silks, from those of Italy and France. A few of the coarser articles of cotton, such as fustians, had begun to be manufactured in the neighbourhood of Manchester: but chintzes, muslins, and all the other articles of finer fabric were brought hither

from India. It is unnecessary to particularize objects of inferior importance and more restricted application, since the same general observations hold equally good with regard to them as to the others.

Foremost in time, and probably not inferior to any in the degree in which he has contributed to the national prosperity, may be placed the late Duke of Bridgewater. A brook which falls into the Mersey between Warrington and Liverpool, had been rendered navigable for a few miles, by deepening the channel, by cutting across the most excursive of its windings, and by erecting at its mouth a flood gate, for the purpose of retaining the tide water. The hint thus offered was soon appropriated and improved by the penetration and genius of his Grace, who, in the year 1757, commenced the execution of a canal for the purpose of conveying coals from his estate at Worsley to the town of Manchester. The subterranean termination of this work in the very heart of the colliery affords the first example of tunneling as applied to navigable canals; and the success which attended the whole undertaking, induced his Grace some time after to project a much larger and more difficult work, the canal which now bears his name. Its purpose was, to open a regular and easy communication between the towns of Manchester and Liverpool, the river Mersey, which before connected them, offering too uncertain and circuitous a road for the proper accommodation of the increasing traffic; and the land carriage, though direct, being too expensive for bulky and heavy articles. By the original genius of Brindley, his engineer, whose magnificence of plan, and fertility in resources, now found a patron entirely worthy of him, this great plan was at length completed, and thus opened the way to that system of internal navigation, the various trunks of which, communicating with each

other, like the blood-vessels of the animal body, carry life and vigour wherever they extend. The mineral treasures of coal and of limestone, which are found so exuberantly in certain districts, while they are entirely wanting in others, now began to extend their benefits to a wider range of country, offering, in the one, to the distant land-holder, the most efficacious of manures at an easy price, and in the other, to the public at large the most indispensable of the comforts of life. The high roads were benefitted to an incalculable degree, by withdrawing from them the transit of the most ponderous articles, and thus rendering their improvement, what it was not before, a practicable undertaking. The manufactures which occasion the greatest consumption of fuel, and require the cheapest carriage, those, namely, of iron, of glass, and of pottery, soon established themselves on these our inland ports, peopling many a wild, till then almost destitute of human habitation.

The same district which had been the first to benefit by canal navigation, was also destined to be the principal seat of that manufacture which, in the course of half a century, has become the staple article of British commerce, and in which the continent of Europe is now running with us the most animated race of rivalry, I mean the production of all those articles of dress and furniture, of luxury, and of use, of which cotton is the raw material.

Early in the last century, the muslins, the chintzes, and other delicate cotton fabrics imported into this country from the East Indies, had begun, in some degree, to supersede the fine linen of Flanders, and the silks of Italy. The cultivation of the cotton plant had been introduced with success into our American and West Indian colonies;

it was raised at a small comparative expense of labour; its produce was abundant, and might, on short notice, be multiplied almost to an indefinite extent. The port of Liverpool, by means of its intimate commercial connexions with America and the West Indies, received a large proportion of the consignments of this commodity, which was disposed of for manufacture chiefly in the neighbourhood of Manchester. After being cleaned, carded, and spun entirely by the manual labour of women and children, the yarn was transferred to the weaver, and made by him, for the most part, into light but substantial articles of clothing. The most tedious part of the process was drawing out the thread, in which no instrument except the common spinning-wheel was employed; the yarn, also, thus produced, bore no comparison in fineness to that which was drawn out by the delicate and flexible fingers of the Hindoo women, so that to attempt to increase the produce, or to improve the quality of the manufacture, and thus enter into competition, even in the home market, with the Indian fabrics, appeared a hopeless undertaking, unless some material improvement could be introduced in the spinning process. Strongly impressed with this conviction, the Society of Arts, as early as the year 1760, offered premiums for a machine capable of spinning six threads at once, and requiring the attendance of only one person. In 1764 some imperfect machines for this purpose were rewarded by this Society, and in the very same year a common weaver, of the name of Hargreaves, constructed one which spun eleven threads. The line of improvement being once pointed out, ingenious men from all quarters rushed into it; one invention prompted another, and the splendid fortunes which were the reward, even of moderate talent, attracted to this branch of industry so large a proportion of enterprise and ability, that the cottons of Manchester and Glasgow now find purchasers, not only in every

corner of Europe and America, but are even forcing their way in the very markets of China and of Hindostan.

When Mr. Watt was once asked by a foreigner in what commodity he dealt, he replied in *Power*: and of all human inventions the steam engine is certainly the most powerful auxiliary that has yet been brought in aid of the strength of man. To the discovery by Dr. Black of the theory of latent heat in 1764, are we indebted for the abstract principle, and to Mr. Watt for the particular application of this principle to the construction of a moving power, capable of acting in any situation, and of condensing, in one spot, the greatest possible quantity of momentum.

The force of wind is irregular and intermitting; that produced by the descent of water is, from its very nature, restricted to comparatively few places; that originating in the live power of men or other animals cannot be accumulated beyond a certain amount in a single effort, or be continued without long intervals of rest. The steam-engine, on the other hand, is not obnoxious to any of these objections; it is uniform in its force, constant in its action, may be erected in any situation, and may be constructed so as to produce a combination of power and of celerity quite unrivalled. It would be wholly superfluous to attempt to particularize the various purposes to which this admirable machine is now applied, whether to give motion to the almost infinite complication of parts composing a cotton factory, or like some mighty giant to wield the ponderous hammer of an iron forge, or draw up a river from the lowest depths to which the courage and perseverance of the miner have yet penetrated. The familiar and almost domestic uses to which it has of late been made subservient, have somewhat detracted from the

sublimity of this magnificent invention; but whoever duly considers either the knowledge and profound combination required in its original construction and successive improvements, or the mighty effects of which it is the immediate cause, will be satisfied of the justice of placing the name of its inventor among the worthies of Britain.

Of those of the last age who yet claim to be held up as examples to the present for meritorious discoveries which have contributed to the high advancement in arts and manufactures for which our native country is so honourably distinguished, the present occasion will only allow me time to select one other name, that of the late Abraham Darby, of Coalbrook Dale. Of this celebrated seat of the iron manufacture, Mr. Darby was the author, by establishing here the first furnace that was ever constructed for the reduction of iron ore by means of coak. An invention which reserved our plantations and forests to better uses than the production of charcoal, which gave up to tillage and pasture many a fertile tract of comparatively unproductive woodland, and especially which, by lowering the price, and facilitating the production of the most useful of all the metals, led the way to that extensive employment of it which is one of the distinguishing characters of the present time. In more senses than one indeed he may be said to have led the way. The iron bridge which spans the Severn at Coalbrook Dale, with an arch above 100 feet wide, was his plan and his construction. Although the first of the kind ever erected, it possesses a character of simple grandeur which has not often been equalled since. Mr. Darby was also, I believe, the inventor of the iron rail way, many miles of which were laid down to facilitate the communication between the various mines, collieries, quarries and smelting works, of the vast establishment of which he was the active head.

I find his name on the books of this Society more than 40 years ago, and we owe to his liberality the fine model of his bridge, which adorns our Repository.

Want of time, not of inclination, prevents me from proceeding farther in the grateful office of recalling to your memories the names of those who, by improvement and discoveries in the useful and ornamental arts, have contributed to the sum of private happiness and of national prosperity.

On some future occasion I may, perhaps, have an opportunity of pursuing the interesting subject; at present I must give place to the more direct business of the day, namely, the distribution, by H. R. H. the President, of the medals and pecuniary gratifications awarded by the Society in the course of the Session.

# PRESENTS
# RECEIVED BY THE SOCIETY

FROM JANUARY 1818, TO DECEMBER 1818.

*With the Names of the Donors.*

A. AIKIN, ESQ., *(the Secretary).*

THOMSON'S Annals, No. 61 to 73, inclusive.

A Print of the Westminster Election.

JAMES ASPERNE, ESQ.

European Magazine, Vol. 72 and 73, 8vo., 1817

ROYAL SOCIETY.

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The 12th Vol., Part 1, of their Transactions.

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*Omitted in the last Volume of Transactions.*

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R. H. SOLLY, ESQ.

Eight Prints.

WM. CASLON, ESQ.

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# A CATALOGUE

OF THE

# MODELS, MACHINES, &c.

*Received since the Publication of the Thirty-fifth Volume of the Society's Transactions.*

## Agriculture.—Class I.

A DOUBLE Drill Turnip Sower, from Mr. John Common. See page 24.

## In Manufactures.—Class II.

A Stretch for Woollen Weavers, from the late Mr. Brierly. See page 56.

## In Mechanics.—Class III.

Mr. Grant's Life Preserver. See page 63.

Mr. J. Henlon's Door Spring. See page 71.

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# RULES AND ORDERS

OF THE

# SOCIETY,

Instituted at London,

FOR THE

## ENCOURAGEMENT

OF

## ARTS, MANUFACTURES,

AND

## COMMERCE.

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# RULES AND ORDERS.

## SECT. I.

*Of the Officers, and Manner of their Election.*

I. THERE shall be one President, sixteen Vice-Presidents, two Chairmen to each of the standing Committees of the Society, a Secretary, an Assistant-Secretary, a Housekeeper, and a Collector of the Subscription Money; which Officers shall be elected, by ballot, on the twenty-second day of April annually; unless when that day happens on a Sunday, or on Good-Friday, or Public Fast-day, in any of which cases the Election to be on the following day; and on that day no other business of the Society shall be transacted.

II. In order to this Election, the President, one of the Vice-Presidents, or, in their absence, some other Member, appointed by the Majority, shall take the Chair at eleven of the clock in the forenoon; two Balloting Glasses, marked A and B, shall be placed before the Chair, the one for receiving the Balloting Lists marked (A), and the other for receiving the Balloting Lists

marked (B), and stand open for receiving Lists until two of the clock in the afternoon; at which hour the Ballot shall be closed, when three Scrutineers to each Balloting Glass shall be nominated by the President, or presiding Member, to examine the Lists; but, in case not more than five Members shall attend to the Vote on that day, the Officers of the preceding year shall be continued till the next General Election. That at the beginning of every Election of a President, Vice-President, or Vice-Presidents, Chairman, or Chairmen, the presiding Member shall begin by calling over the names of the persons proposed as Candidate or Candidates for that Election, in order that it may be known whether such Candidate or Candidates be in arrear; and that no Member shall be eligible to be a Candidate for President, Vice-President, or Chairman of a Committee, whose Subscription shall be one year in arrear.

III. A sufficient number of printed Balloting Lists of all the Officers in being, according to the forms annexed (A B) shall be ready; containing also the names of the Members (if any) recommended by the Committee of Election.

IV. Each Member shall deliver his Lists folded up to the President, or presiding Member, to put into the Glasses; and the Collector, sitting on the side of the Chair, with a List of the Members before him, shall mark the name of each Member so delivering in his Lists.

V. When the Ballot is closed, one of the Scrutineers shall open and read aloud each List, and file it, while the other two or more mark the names; and when all the Lists are drawn, the marking Scrutineers shall cast up and report the same to the Chair; after which, the President, Vice-President or presiding Member, shall declare the persons who have the Majority of Votes to be the Officers respectively for the ensuing year.—Such Elections shall likewise be declared again at the next Meeting of the Society.

VI. If the President, or any of the Vice-Presidents shall resign or die, the remaining Vice-Presidents shall continue to act and preside at the Meetings of the Society, in the order they are placed in the Election List, until the next annual Meeting for the choice of Officers, or some other General, or extraordinary General Meeting, which the Society shall please to appoint for such particular Election.

VII. If any of the offices of Secretary or Assistant-Secretary, Housekeeper, or Collector, shall become vacant, a person shall be appointed, at the next Meeting of the Society, to act in such respective office of Secretary, Assistant-Secretary, Housekeeper, or Collector, until the next General Meeting, or an extraordinary General Meeting, which shall be appointed for electing a person by ballot, to fill the vacant Office for the remaining part of the year.—In case the Office of Secretary, Assistant-Secretary, House-

keeper, or Collector, be at any time resigned, which resignation shall take place on a subsequent day, it shall be in the power of the Society to proceed to the Election of a proper person to fill such Office on such resignation taking place, or to nominate one to hold it *pro tempore*, until such office shall be filled up. But no person shall be entitled to ballot at the Election of any of the said Officers, in case of a vacancy by death, resignation, or removal, who shall not have been a Member previous to the declaration of such vacancy, unless he shall become a perpetual Member.

VIII. At all Elections of Officers, if the suffrages should be equal, the decision shall be by lots, prepared by the Scrutineers, and drawn by the President, Vice-President, or presiding Member.

IX. Notice of the annual, or of any occasional Election of Officers, shall be published three different days, in such Newspapers as the Society shall order, one week at least before the day of Election.

X. Notwithstanding the Election of Officers is annual, the Society reserve to themselves the power of removing either the Secretary, Assistant-Secretary, Housekeeper, or Collector, by two General or extraordinary General Meetings: in which case, the said Officers shall be paid their salaries in such proportions as may be then due to them.

XI. Neither the Secretary, Assistant-Secretary, the Housekeeper, nor the Collector of the Subscriptions, shall be Members of this Society.

XII. No person, except he shall have been an Officer the preceding year, shall be admitted as a Candidate for any lucrative employment, without having personally presented his Petition or Memorial to the Society, sixteen days before the day of Election; which Petition or Memorial shall be read immediately after the first, and again after the second reading of the Minutes. And in case of its being referred to a Committee to examine and report on the qualifications of the Candidates for any lucrative Office, such Committee shall not enter on their examination of the Candidates, until within fourteen days of the day fixed for the Election (of which Meeting for examination, notice shall be given to all the Candidates), and they shall examine all the Candidates who attend for such purpose, in the order in which their names occur in the Alphabet. No Member of this Society shall be eligible as a Candidate for any lucrative employment in the gift of the Society, who shall be present, or act as a Member, at any Meeting or Committee of the Society, after he has declared by word, message, or otherwise, his intention of becoming a Candidate.

XIII. No Officer who receives a salary, or Servant, shall be entitled to any Premium or Bounty whatever from the Society.

XIV. No Officer or Servant shall presume, under any pretence whatsoever, to accept of any Present or Gratuity from any Candidate for a Premium or Bounty, or any Tradesman having dealings with the Society, or any person coming to see the Machines, on account of such Premium, Bounty, Dealings, or Inspection.

XV. No Officer, Servant, or Person, employed to show the Machines in the several Repositories, shall accept any Gratuity from the Maker or Seller of any Machines made after the Models or Machines for which the Society have adjudged any Premium or Bounty.

XVI. A Messenger shall be chosen or removed at any Meeting of the Society; and so long as he continues in their service, he shall be paid a salary of seventy pounds a-year.

## SECT. II.

### *Duty of the President, Vice-Presidents, and Chairman.*

I. The duty of the President, Vice-President, (in the order they appear in the List), or Chairman, is to preside at all Meetings, with his hat on if he pleases, to regulate the Debates of the Society; to state and put questions, both in the affirmative and negative, according to the sense and intention of the Meeting; to check irregularities, and keep all persons in order; to direct

summons for all extraordinary General Meetings; and to execute, or see to the execution, of all the Rules and Orders of the Society.

II. The President, or any one of the Vice-Presidents, shall sign Receipts for the Subscription Money, on receiving, in writing, from the Secretary, a requisition from the Committee of Accounts to that effect.

## SECT. III.

### *Business of the Secretary.*

I. He shall attend all Meetings and Committees of the Society; he shall take down all Minutes of the Committees, and produce them fairly written at the ensuing Meetings. He shall read all the Minutes of the Meetings and Committees to the Society; and translate such communications into English as shall be in any other language. He shall prepare all answers, when ordered by the Society, in such language as shall be directed, and lay the same before the Committee of Correspondence, for their examination, unless the Society shall judge an immediate answer necessary. He shall prepare an annual Historical Register of the Transactions of the Society, beginning every year from the first day of July, and ending the last day of June following. This Register shall contain an account of all Premiums bestowed, with the

names of the Persons who have received them, digested under proper heads: a List of the Premiums offered by the Society, and upon what condition, and the number of Members. He shall also prepare an account of the amount of Annual and Life Subscriptions separately, and of the money in the Bank, as they stood on the last day of June, and of other sums received during the preceding year; and what have been the expenses, in Officers, Servants, Apartments, and Workmen's and Tradesmen's Bills of all sorts. He shall prepare the List of Members, Advertisements, and other Publications ordered by the Society; and take care that the same be properly and correctly printed: and his name, or that of the Assistant-Secretary, as by order of the Society, shall be signed to all Publications. All the Letters or Written Papers of the Society shall be kept under his care, and ready to be produced by him for the inspection of the Members. He shall visit manufactories, or apply to the manufacturers for information, when required by the Society; and he shall, as much as possible, endeavour to make himself acquainted with the nature and circumstances of the several arts and manufactures of this and other countries.

II. The Secretary shall be paid in advance the sum of twenty pounds, to meet incidental and other payments, not exceeding five pounds, which shall be entered in a book kept for that

purpose; this book shall be laid before the Committee of Accounts at every Meeting of the Committee. The sums thus expended shall be made good by a draft on the Banker.

III. The Secretary shall read the whole of the Eleventh Section of the Book of Rules and Orders, at the time when the Standing Committees are appointed to be declared in the Society; and also at the opening of the Business in the General Committee of Election, ordered to be holden on the Friday following annually. And in consideration of his constant attendance, abilities, and diligence, he shall be paid a salary of two hundred and fifty pounds a-year, and be supplied with coals and candles.

## SECT. IV.

### *Business of the Assistant-Secretary.*

I. The Assistant-Secretary shall attend every day at the Office of the Society from the hours of ten to two, during the Sessions of the Society, and such further time as may be necessary to perform the business of the Society in his department, and at all Meetings of the Society, and read the letters received. He shall likewise attend Committees, when particularly ordered by the Society, or by one of the Chairmen of such Committees. He shall take down all Minutes of the Society's proceedings, and pro-

duce them fairly written in the Minute Book of the Society at the ensuing Meeting. He shall make Indexes to all the Minute Books, and to the Transactions of the Society intended for publication. He shall paste all Letters and Papers in the Guard Book. He shall transcribe all Papers or Letters that have been prepared by the Secretary, or approved by the Society, or by the Committee of Correspondence and Papers. He shall, together with the Secretary, examine the Proofs and Revises of the Society's Publications—And as a satisfaction for such services, he shall be paid a salary of one hundred and twenty-pounds a-year.

II. Any Member having obtained leave to take Copies of the Proceedings or Papers of the Society, shall pay to the Assistant-Secretary, for writing the same, after the rate of two-pence for every hundred words.

N. B. All the written Books of the Society shall be kept in the Society's Office for the inspection of the Members.

## SECT. V.

### *Business of the Housekeeper.*

I. The Housekeeper shall have an apartment in the house of the Society, that she may be

ready on the spot to receive Messages, Letters, and all matters brought to the Society; to answer all Inquiries; and deliver Plans, Lists, &c. to such Members as shall come or send for them, of which she shall take care to have a sufficient number. She shall have the custody and care of all the Furniture, Books, such Papers as the Society shall think proper, and other Effects whatever, belonging to the Society. She shall have the direction of all the inferior servants. She shall receive and have charge of all the matters sent to the Society by candidates for premiums, and shall enter them properly, at the time when delivered, in a book for that purpose. She shall keep a fair inventory of all the Goods and Effects of the Society, to be always ready when called for. She shall keep an account of all Stationary Wares, Printed Books, Coals, Candles, and all other particulars sent in by tradesmen for the use of the Society, in a Day Book for that purpose; and shall enter the same fairly, under their several heads, in another book, to be laid every month before the Committee of Accounts, as a check on tradesmen's bills. For all which services she shall be paid a salary of seventy pounds a year; and fifty pounds to pay the servants, for cleaning the rooms and furniture, and other incidental charges to which she is liable.

## SECT. VI.

### *Business of the Collector.*

I. The Collector shall give such security as the Society shall require, for the trust reposed in him. He shall collect the Subscription Money from the Members, as it becomes due, paying to the Society's Banker on the Saturday in every week, all the Monies he shall have collected since the last day of paying in.

He shall attend all the Meetings of the Committee of Accounts; and at every Meeting of that Committee, he shall give in an account of all Monies received by him since the last Meeting of the Committee.

He shall enter into the General Name Book all Members as they are elected, with the sums which they subscribe annually; and he shall, at each Meeting of the Committee of Accounts, give in a List of those Members who have declined, and of those who have died since the preceding Meeting. He shall deliver to the Chairman of the Committee of Accounts, on the last day of January in every year, an account of the Members who have paid in the preceding year, as likewise how many were elected, declined, or remained in arrear in that year. For all which services he shall be allowed one shilling in the pound on all such

contributions, but not on legacies and particular donations. He shall attend all Meetings of the Society, and shall hand round the Balloting Box on every occasion where a ballot is required, for which duty he shall receive ten pounds a year.

He shall deliver the Annual Volumes of the Society's Transactions to those Members who reside in the Metropolis, for which service he shall be paid the sum of fifteen pounds.

II. And whereas a Collector, with whose conduct the Society may be well satisfied, may happen to be unavoidably prevented, through sickness or accident, from performing his duty, at a time when it may be prejudicial to the Society to have the collection delayed; or a Collector may have given such cause of dissatisfaction as to render his suspension expedient, and the time requisite for a proper examination into his conduct, before he may be either restored or justly removed, may occasion a prejudicial delay in the collection; the Society, to obviate these inconviences, reserve to themselves the power of suspending in the latter case, a Collector, at any ordinary Meeting, when twenty Members at the least are present; and upon confirmation of such suspension, of appointing, in either of the said cases, a temporary Collector, which appointment shall not require confirmation.

## SECT. VII.

*Meetings of the Society.*

I. THERE shall be five General Meetings every year, in the Great Room of the Society, at seven of the clock in the evening precisely, viz., on the first Wednesday in February, the third Wednesday in April, the second Wednesday in May, the second Wednesday in November, and the second Wednesday in December; at which Meetings, or at any Extraordinary General Meetings only, if fifteen Members at least are present, Rules and Orders for the Government of the Society may be made and altered; and such rules, orders, and alteration, being approved at the next succeeding General or Extraordinary General Meeting, shall be valid and binding.

II. An Extraordinary General Meeting may be called, if twenty Members, at the least, are present, and the majority shall desire such Extraordinary General Meeting; which Extraordinary General Meeting shall be advertised three days successively in two of the daily papers: and if fifteen Members are present, they may proceed to business.

III. No proposition shall be offered to the Society, as matter of new rule and order, or which shall contain in it an alteration or amendment, of any established rule and order, unless delivered in by a Member, ten days before a

General Meeting of the Society, to the Secretary, who shall immediately cause copies to be made of it, and to be hung up in the Society and Committee Rooms, containing the date of the ensuing General Meeting, when the same is to be taken into consideration. At the next General Meeting, the Secretary shall, immediately after reading the Minutes of the preceding Meeting, read all such propositions once over, according to the order they have been delivered in; which Propositions shall be read a second time, with a proper pause after each: and if any of those Propositions be moved and seconded, it shall then be taken into consideration.

IV. All new Rules and Orders, once passed, are to be hung up in the Society's Room till they are confirmed, with the date when passed the first time, and when to be confirmed.

V. All new Rules and Orders shall be signed by the President, or the Vice-President, and undersigned by the Secretary, and hung up in the Society Room and Committee Room, for the information of the Members, till such time as they are inserted in their proper places in the subsequent printed book of Rules and Orders.

VI. The ordinary Meetings of the Society shall be held on Wednesday in every week, at seven of the clock in the evening precisely, from the first Wednesday in November, to the second Wednesday in June; and from the second Wednes-

day in June, to the first Wednesday in November, there shall be no Meeting of the Society, unless called by the President, or two Vice-Presidents, on extraordinary occasions, and proper notice given thereof in the daily papers. And if at such Ordinary Meetings there should be present eleven or more Members, they may proceed on business; but, in case there should not be eleven Members present at seven o'clock, they may proceed on business with nine Members only. And the said Meetings shall have power to appoint such Committees as they think necessary.

VII. An Extraordinary Meeting, for the doing of common business only, may be at any time ordered by the Society, in the same method as an Extraordinary General Meeting.

## SECT. VIII.

*Order of the Proceedings of the Society.*

I. The Book of Rules and Orders, List of Premiums and of Members, shall lie upon the table before the President, or presiding Member at all Meetings and before the Chairman at all Committees.

II. Each Member is at liberty, before the President, Vice-President, or presiding Member takes the Chair, to deliver to the Secretary, in writing, the names of no more than two persons

whom he desires to be admitted auditors at that Meeting; which names the Secretary shall enter in a list, together with the name of the Proposer. The List shall be read as soon as the Chair is taken; and, if not objected to, the Collector shall carry the same to the Committee Room, and there call over the several names; when the persons allowed to be present may enter the Great Room, and seat themselves among the Members, but shall not be permitted to debate or vote.

III. Persons desirous of being admitted Auditors, are to remain in the Committee Room, until their names are called over by the Collector.

IV. No person to be admitted an Auditor at any Meeting of the Society, unless introduced by a Member; nor shall any Member propose an Auditor to be admitted after the chair is taken.

V. No Auditor to be admitted at the Meetings of the Society but those who shall have obtained leave of the Society, or Members of the Societies of the same kind in Scotland and Ireland.

VI. No Member, whose subscription shall be beyond the current year in arrear, shall be at liberty to propose an Auditor to be present at any Meeting of the Society; and the Collector is directed to attend to this circumstance.

VII. At all Meetings, business shall begin

at seven o'clock in the evening with reading the Minutes of the preceding Meeting; but no part of such Minutes shall be discussed till the whole has been read through.

VIII. Candidates shall be ballotted for, and, during the ballot, the business of the evening shall be proceeded on.

IX. The Minutes shall be read a second time; and no other matter shall be proposed till the said Minutes have been discussed, article by article: and all parts of the Minutes, which are not objected to at the second reading, shall stand confirmed.

X. The President, after the first reading of the Minutes, is to declare, that every Member is entitled to vote and assist in all the transactions of the Society and its Committees, unless his first subscription shall not have been paid; and that no Member shall speak more than once on one and the same question, unless called upon from the Chair to explain himself, excepting only the original proposer of any new Motion, who shall be allowed the liberty of replying once on such occasion; and that no person is entitled to be present at any Meeting or Committee, whose subscription shall be at any time for two full years in arrear; and that no person shall be entitled to debate, or vote at any Meeting or Committee, until his subscription for the current year, and all arrears, are paid.

XI. Reports from Committees shall be made; and the adjournment of those Committees, which have not finished the business referred to them, shall be declared to the Society.

XII. All Reports from the different Committees shall be made to the Society in succession, according to their respective dates, unless when ordered otherwise by the Society.

XIII. A Report from a Committee, except in the case of a Bounty, shall not be recommitted but by a majority of two-thirds.

XIV. New matter to be considered.

XV. The President, or presiding Member, shall then read over to the Society the subjects the Committees are to discuss the following days.

XVI. Letters to be read.

XVII. No question shall be put on any Motion, unless the Motion be seconded.

XVIII. No Motion shall be permitted for the repealing any confirmed Resolution of the Society, till such Resolution has been in force three months; nor shall any Motion that has been rejected be made again, till after three months from the time of its rejection.

XIX. No new Proposition shall be entered upon after ten of the clock at night, unless the Motion be read from the Chair before ten o'clock.

XX. No Member, on any pretence whatsoever, shall be at liberty to move, that he may

have leave to make a Motion after ten of the clock.

XXI. No Premium shall be offered to the public unless it has been approved of by a Committee, and agreed to by the Society, at one Meeting, if the Premium shall have been already published in the Society's Transactions; or at two Meetings of the Society, if it be a new Premium: and no Premium or Bounty shall be given to any Candidate, unless the Society, at two Meetings, shall be satisfied that such Candidate does really deserve the same.

XXII. When any proposal is made for a Premium or Reward, and the Motion made and seconded, it shall be delivered to the Chair in writing, and the same shall be read twice.

XXIII. No Motion shall be made for the dispensing with any condition of a Premium as offered in the advertisement, on any pretence whatever.

XXIV. That no Model, or Machine, be, on any pretence whatever, lent, or suffered to be taken out of the Society's Repository, but by special vote of the Society, or, during the recess, by a Resolution of the Committee of Correspondence and Papers.

XXV. No Proposition shall be carried into execution till it is approved and confirmed by the Society at two subsequent Meetings; but, if a negative be put upon an affirmative Proposition, or a negative Proposition be agreed to,

such decisions shall not require confirmation. But this article only applies to ordinary Meetings.

XXVI. If, at the second reading of a Proposition, any alteration shall be made by way of amendment, such alteration shall not want the confirmation of another Meeting, unless the Society shall increase a Premium, Bounty, or any other expense; in which case it shall require the confirmation of another Meeting.

XXVII. No Member shall be permitted to be on the area or space between the tables, while the Society is proceeding on business; nor shall any Member stand up within the seats, unless it be to speak, or to go from or return to his place therein.

XXVIII. When any Member speaks he shall stand up and address himself to the chair, and the rest shall remain silent.

XXIX. When two or more offer to speak together, the President or presiding Member, shall determine who shall speak first.

XXX. The Member that speaks to order shall be first heard.

XXXI. When a matter is in debate, if any Member speaks to new business, the President, or presiding Member, shall interrupt him; but the circumstance of the previous question being moved by any Member during the debate on any Motion, does not necessarily preclude the continuation of such debate.

XXXII. When on any Question an equal number of hands appear to be held up for and against the same, the President or presiding Member shall appoint two Members to count and report the numbers to the chair.

XXXIII. In all Meetings and Committees, the President, or presiding Member, shall only vote when the suffrages are equal.

XXXIV. The opinion of the Society shall be taken by ballot, instead of hands held up, if desired by five Members.

XXXV. A division shall not be granted but upon the request of six Members.

XXXVI. No new matter, either respecting the government of the Society, or the measures for the improvement of Arts, Manufactures, and Commerce, shall be received, unless it be laid before the Society in writing.

XXXVII. At every Meeting of the Society, all the Resolutions of such Meeting shall be taken down at large, and read aloud by the Assistant Secretary immediately after they have been respectively agreed to.

XXXVIII. No Meeting shall be adjourned until the majority of the Members present, upon the question being put and seconded, shall agree thereto; nor shall the question be put, until the names of the candidates proposed at such Meeting have been read.

## SECT. IX.

*Order of Proceedings at a General or an Extraordinary General Meeting.*

I. The Minutes of the preceding Ordinary Meeting shall be read.

II. The President, or presiding Member, shall then declare the Meeting to be a General or an Extraordinary General Meeting.

III. The Minutes of the preceding General Meeting shall be read the first time; and after a short pause shall be read a second time; when such parts as are not objected to, shall stand confirmed.

IV. New matter relative to such Meetings only may be proposed and discussed.

V. If, after a proper pause, no new matter is proposed, then the General or extraordinary General Meeting shall be adjourned to the next General Meeting in order; after which, the usual business is to go on.

VI. Every proposition that is to be discussed at a General Meeting, shall be publicly read by the Secretary, on the preceding Wednesday, immediately after the second reading of the Minutes, and usual declaration from the Chair.

## SECT. X.

### *Election of Members.*

I. No Person is to be proposed for a Member, unless recommended by three Members; and the name, place of abode, and addition of the person recommended, shall be delivered in, signed by the Proposers, which shall be read by the Secretary, who shall insert the name in a List of Candidates, to be hung up in the Society and anti-rooms, until the following ordinary Meeting of the Society, at which such persons shall be ballotted for, provided there be fourteen days between the Meetings: The names of the Proposers, together with the name and addition of the person to be balloted for, shall be put upon the ticket, placed on the box, during the time of such ballot. The Collector, having a sufficient number of balls, shall give one to each of the present balloting Members, and, if two-thirds of the Members then voting shall ballot in his favour, he shall be deemed a perpetual Member, upon payment of twenty Guineas at one payment; or a subscribing Member, upon payment of any sum, not less than two Guineas annually, (BB). Peers of the Realm, and Lords of Parliament, desirous of becoming Members of this Society, shall, on their being proposed at any Meeting of the Society, be immediately balloted

for. Ladies are eligible as Members of this Society, are entitled to attend and vote in its Proceedings and Committees, and are alone entitled to vote by Proxy on Elections only, through the medium of some Gentleman who is a Member, but such Member must produce a written authority from the lady for whom he votes as Proxy.

II. In Election of Members, a second Ballot shall be granted, if immediately demanded.

III. Every person, upon his Election, is to pay his Subscription Money, or one of the Members is at liberty to make the deposit, in his name, in case of absence.

IV. Every Member shall pay his Subscription Money in arrear within one month after he has been applied to by letter from the Collector for that purpose, according to the copy annexed, (C); and no person shall be entitled to debate or vote, at any Meeting or Committee, until his Subscription for the current year, and all arrears, are paid: And no person shall be entitled to be present at any Meeting, or Committee, whose Subscription shall be at any time for two full years in arrear: Yet as several, who have declined continuing their Subscriptions for a time, may be again desirous of becoming Members, but by the foregoing Rule and Order seem to be precluded until their arrears shall be discharged, it is hereby ordered, that any such person shall be capable of being re-elected a

Member of the Society, in the same manner, and on the same terms, as if he had never been a Member before.

V. When any person is elected a Member, the Secretary shall immediately inform him thereof by a letter (D); and the Collector shall wait upon him, if in town, and carry a printed book of Rules and Orders, and the List of Premiums.

VI. The names of such persons as have not paid their first Subscription Money, are to be omitted in the List of Members.

VII. Foreigners, or Persons who do not reside in Great Britain, may be elected, by ballot, corresponding Members of this Society, without being subject to any annual payment: and shall be admitted to the Meetings and Committees of the Society during their residence here, provided such residence does not exceed three months at one time; but shall not be permitted to vote.

VIII. On Election of any person to be a corresponding Member of this Society, a letter shall be written by the Secretary, acquainting him therewith; and the Secretary, in such letter, shall enclose him an exact copy of the standing Rule and Order, "That no Member of "this Society shall hereafter be a Candidate for, "or entitled to receive any Premium, Bounty, or "Reward, except the Honorary Medals of the "Society;" and also, that the Society request

their corresponding Members, as often as shall be convenient, to favour them with accounts of such useful discoveries or improvements in any of the Polite or Economical Arts, as may come to their knowledge.

## SECT. XI.

### *Of Committees.*

I The Standing Committees for the year shall be declared, and the Members thereof shall be named by the Society, at eight o'clock, on the first Wednesday in April, and a General Committee of Election, to which the Chairmen and Members of the several Committees shall be especially summoned, shall meet on the Friday next ensuing (provided the same be not Good-Friday, but, in that case, the Committee shall be summoned for the Thursday preceding) to take into their consideration the choice of two Chairmen to each of the several Committees for the following year, and report their names to the Society, on the second Wednesday in April, as proper persons to serve as Chairmen in the respective Committees, under the Titles of which they shall be severally inserted, as follows :—

Committee of Accounts.

Correspondence and Papers.

Agriculture.

Committee of Chemistry, Dyeing, and Mineralogy.
Polite and Liberal Arts.
Manufactures.
Mechanics.
British Colonies and Trade.
Miscellaneous Matters.

And they are to report and recommend them to the Society as proper persons to be elected at their annual Election of Officers, to be held on the twenty-second day of the same month.

II. Nine Committee Minute Books are to be kept; one for each of the above-mentioned Committees.

III. Two Chairmen shall be elected by Ballot, for the Committee of Accounts, Committee for Miscellaneous Matters, Committee of Correspondence and Papers, and each Class of the Committee of Premiums severally; who shall preside for that year when present, in the order they are named; and in case neither of the said Chairmen should be present at their respective Committees, any other Member shall be appointed by the Committee, Chairman for the occasion.

IV. Committees shall not take up any matter, unless referred to them by the Society; and no decision on the merits of any Question referred to the Committee shall be made after eleven o'clock.

V. All Committees shall be summoned, and the matters referred to them shall be specified in the respective summons; and when any matter is referred to any of the Committees of this Society, the mover thereof shall be summoned to attend such Committee when the same is taken into consideration.

VI. All Committees shall have power to adjourn themselves as they think fit; and, notwithstanding particular gentlemen are named for each Committee, every Member is of every Committee.

VII. If a Member shall signify to the Secretary his intention to attend any Committee, he shall be summoned to it; and the Secretary shall be directed to summon such other Members and other persons as the Chairman apprehends to be most conversant in the business to come before them; which business also shall be declared in the summons: and three Members shall constitute a Committee.

VIII. In order that every Member may be the better informed of the times of the Meetings of the several Committees; in general cases they are fixed in the following manner:

Committees of Correspondence and Agriculculture on Monday.

Colonies and Trade, and Manufactures, on Tuesday.

Mechanics, on Thursday.

Polite Arts, on Friday.

Chemistry, on Saturday.

Accounts, in the first week in every month.

IX. It is the duty of a Chairman to observe, that no question be put to the Committee unless three Members are present; and before an adjournment of such Committee, or Report concluded, that the Minutes be read, and signed by the Chairman, who shall certify that three Members at least were present. And the Chairman is requested to attend the Reports of the Committee in which he presided, when such Reports are made to the Society.

X. The Chairman shall take care that regular Meetings of the Committee be appointed, and that their Reports be made, fairly written, and without blanks, so soon as any one or more of the subjects referred for their consideration have been disposed of; or when they may deem it requisite to gain further directions from the Society; but in case upon appointment of a Committee, a sufficient number do not attend, the Chairman is required to appoint another day, and shall direct the Secretary to summon the Committee on a future day, at a distance of not less than three days inclusive.

XI. There shall be constantly hung up in the Society's Room and Committee-Room, a List of all Committees, specifying the business they are to consider, and the days they are appointed to meet.

XII. No pecuniary or other Reward shall be given to any candidate for a Premium or Bounty, for his trouble or attendance on any Committee, to whom such matter shall be referred by the Society for their consideration, unless by order of the Society.

XIII. All references to the several Committees shall be entered in the respective Committee-Books, in one List, at the beginning of such Books, in order that the subjects of them may be regularly taken up.

XIV. Lists of Reports that are ready to be made, or standing for confirmation, with their dates, shall always be hung up in the Great Room.

XV. Every Committee shall direct the Secretary to write to one or more of the persons subscribing any Certificate in claim of a Premium in Great Britain, or to such other person as the Committee may think proper, for further information of the truth of such Certificate, and shall wait for an answer as to the reality of their having signed the same, before the adjudication of such Premium.

*Provincial Committees.*

That Members of this Society residing in Manufacturing or Commercial towns, or in the country at a distance from London, be recommended to form themselves into Committees in their respective neighbourhoods.

Each Committee to elect an honorary Secretary from amongst themselves, to correspond with the Secretary of the Society; and any communication which shall be received from the provincial committees will be attended to by the Society, and such as, in the opinion of the Society, shall contain information which may be useful to the public, will be printed in the Society's Transactions.

The Secretary of each of the provincial Committees to send to the Society an annual List of the names of the Members of such Committee.

The provincial Committees to furnish the Society with information respecting the claims for Premiums sent from their respective neighbourhoods.

The Society will provide the provincial Committees with sufficient numbers of its Rules and Orders and Lists of Premiums for distribution, but reserves to itself the privilege of presenting sets of its Transactions to provincial Committees, and of affording them such other privileges as may from time to time appear advisable to the Society.

The Society recommend to the attention of the provincial Committees, the several objects of the Society, as detailed in its List of Premiums, and to propose to the Society any other Premiums by which they think its beneficial influence may be extended, and to communicate any improvements which have been practised in their

respective neighbourhoods. Their attention also is particularly invited to the natural and mineral productions of the country, and it is desirable they should transmit to the Society specimens of such as they think may be advantageously employed in any of the Arts or Manufactures of the country, and should they request to have information respecting them, such request will be attended to by the Society, and the specimens analyzed if necessary.

The provincial Committees will likewise be expected to favour the Society with Models or Descriptions of any ingenious Machines, or other new and useful Inventions which may come to their knowledge, connected with the Manufactures of the country; particularly such as shall be invented by any person, who from inadequacy of means, may be unable to bring it before the public.

## SECT. XII.

### *Of Rewards.*

I. The chief object of the attention and encouragement of the Society, in the application of their Rewards, are ingenuity in the several branches of the Polite and Liberal Arts; useful Inventions, Discoveries or Improvements in Agriculture, Manufactures, Mechanics, and Che-

mistry; or the laying open any such to the public: and in general all such useful Inventions, Discoveries, or Improvements, as may appear to have a tendency to the advantage of Trade and Commerce.

II. The Society reserve to themselves the power of giving in all cases, such part only of any Premium as the performance shall be judged to deserve, or reserving the whole if there be no merit.

III. The Premiums of the Society shall extend to Great Britain and Ireland, and all the British Isles.

IV. No Member of this Society shall be a candidate for or entitled to receive any Premium, Bounty, or Reward whatsoever; except only the honorary Medal of the Society. And no Member having delivered in his claim for any Premium offered by the Society, and afterwards withdrawn the same, shall be entitled to take a part in the deliberations, or vote on the claims of other Candidates, who may have claimed such Premium.

V. No Member who is a Candidate for the honorary Premium or Medal of this Society, shall be of the Committee to which such matter may be referred; or ever present at their sittings, while the subject is under consideration, unless called in to answer such questions as the Committee may propose; nor shall any such candidate be present in the Society when the matter

is before them, whether in debate, or for determination, unless called in. Which Rules, all Members being such Candidates, are strictly to observe, under penalty of forfeiting their title to such Medal, notwithstanding any determination of the Society in their favour.

VI. If any Member shall be afterwards found to have transgressed the Rules mentioned in the preceding Resolutions, by the means of a borrowed or fictitious name, such Member shall be expelled the Society.

VII. No Member, who is the father, son, or master of a Candidate for a Premium, Bounty, or Reward, nor any person anywise lucratively interested in such an event, shall be of the Committee to which such matter is referred; nor present in the Society when it is under consideration, unless called in, under penalty of excluding such child, father, scholar, apprentice, or servant, from all title to any such Premium, Bounty, or Reward, notwithstanding a determination of the Society in their favour.

VIII. A Candidate for a Premium, or person applying for a Bounty, being detected in any disingenuous methods to impose on the Society, shall forfeit any such Premium or Bounty, and be deemed incapable of obtaining any for the future.

IX. No Candidate who is not a Member, shall be present at any of the Meetings of the Society or Committees, or admitted at the Society's

Rooms, after they have delivered in their claims, till such claims are adjudged, unless summoned by the Committee, under forfeiture of the Premium or Bounty for which they are candidates.

X. No Machine, or Model of a Machine shall be admitted to claim a Premium, unless the whole and every part thereof, shall be delivered into the Society's office at or before the time appointed by the Society. And if any Candidate shall secretly make addition to, or alteration in his Machine or Model, otherwise than by repairing and putting the several parts together, after it is lodged with the Society, he shall, on discovery, be deemed incapable of receiving any Premium.

XI. The Society shall, whenever they think proper, desire the assistance of such gentlemen, manufacturers, or others, though not Members of it, as shall be deemed best able to judge of, and discover the truth and value of any matter or thing for which a Premium has been claimed.

XII. No Medal, or sum of Money, shall be given as a Bounty or Reward for any thing not mentioned in the List of Premiums at any time, unless fifteen Members are present; and the Majority to bestow such Medal or sum of Money, shall consist of two-thirds, at least, of the Members then present: the same to be confirmed by Ballot.

XIII. If a claim for a Premium shall be re-

jected by the Society, no motion shall be made for giving to the Candidate, in lieu of such Premium, any Bounty of equal honour or value with the Premium offered.

XIV. Every person who shall receive any Premium or Bounty from the Society, shall relinquish all pretensions to a patent for any matter for which he has obtained such Premium or Bounty. No Model or Machine for which a Patent has been obtained, or is proposed to be obtained, shall be admitted into the Repository of the Society.

XV. No Member who has obtained a Patent for any article similar to such as may be produced to the Society, shall be allowed to vote either in the Committee or Society on that subject.

XVI. If any Reward be conditionally voted by the Society, and the imposed conditions be not completed within one year from the time of such vote, the reward is to be considered as void, unless further time shall be granted by the Society for complying with the said conditions, in consequence of an application in writing made by or from the said claimant.

XVII. The several Candidates and Claimants to whom the Society shall adjudge Premiums or Bounties are to attend at the Society's house in the Adelphi, or such other place as shall be appointed, on the last Tuesday in May of that Session, at eleven in the morning precisely, to receive the same; that day being appointed by

the Society for the distribution of their Rewards; and before that time no Premium or Bounty will be delivered, except to those who are about to leave the kingdom.

In cases where the Society may think fit to admit excuses for not attending in person, deputies may be substituted to receive the Rewards, provided such deputies are either Members of the Society, or superior officers thereof.

At the Annual Distribution of the Society's Rewards, no Member shall be at liberty to give tickets for the admission of more than two ladies and one gentleman, as auditors at the distribution of Premiums.

The tickets to be issued from the Secretary's office, and signed by the Member who gives them; and not more than one individual shall be permitted to attend as a visitor on that day for each order or ticket of admission.

XVIII. The Isis Medal shall be considered and called the lesser Medal of the Society.

## SECT. XIII.

### *Resolutions.*

I. That all Models of Machines, for which persons obtain Premiums or Bounties, shall become the property of the Society, and correct written descriptions be furnished with them;

and where Machines are rewarded, that complete models, or correct drawings, and proper written explanations, be delivered to the Society by the persons entitled to such Rewards.

II. That no Machine, Model, Painting, Drawing, or Papers, be returned to any Claimant or Candidate, without an order from the Vice-President in the Chair; or from one of the Chairmen of the Committee to whom such Machine, Model, Painting, Drawing, or Papers may have been referred.

III. All the written Accounts, for which any Premium is offered and given, or for which the Society have given a Bounty, shall be published; such accounts being first referred to a Committee to prepare them for publication.

IV. With the List of Premiums, an account of all the Medals, Premiums and Bounties, which have been given by the Society the preceding year, to whom and for what purposes, shall be printed annually.

V. In the List of the Members, after the name of each Member, his addition and place of abode are to be inserted.

VI. The Committee of Correspondence are at liberty from time to time, to refer such letters as they esteem proper to the respective Committees, without reporting them to the Society, in order to be referred to such Committee; except such as propose the granting any new Premium or Bounty.

VII. All the Books of the Proceedings, Correspondence, &c. of the Society, shall be kept in the Society's Office to be inspected by Members at any reasonable hour; the Housekeeper having for that end a key of the presses.

VIII. Members wishing to obtain copies of Papers belonging to the Society, shall give a list of such Papers as they want, which lists shall be read by the Secretary.

IX. That no book be purchased for the Library of the Society, until it has been recommended by the Committee most competent to judge of its merits and usefulness.

X. No Member is to be permitted to borrow from the Library more than either one folio, one quarto, or two octavo or 12mo volumes at one time, but that this liberty shall not be construed to extend to Manuscripts, the Transactions of Literary and other Politic Bodies, Lexicons, or Dictionaries, which shall on no account be lent out of the Library, unless by special Vote of the Society.

No Member is to be permitted to keep any book longer than fourteen days.

A book is to be provided by the Housekeeper, in which the titles of the books borrowed, with the names of the person borrowing the same, shall be inserted by the Member who borrows such books, and when they are returned, countersigned by the Housekeeper

That such book of the Housekeeper be laid

before the Chairman of the Miscellaneous Committee at every Meeting thereof, in order that it may be seen that the above Regulations be properly attended to.

XI. No person shall be permitted to make any Sketches, finished Drawings, or Paintings, from any Statues, Busts, Casts, Drawings, Prints, or Pictures in the Society's possession, without leave first obtained from the Society.

XII. That the Society do not, under the notion of varnishing, touching, or on any account whatever, suffer any painter to meddle with the series of pictures in the Great Room.

XIII. That for the better regulation of the dealings of the Society with tradesmen and others, all persons having any claims on the Society, be in future directed to send in an account of their demands once in every three months from the time of their accruing; and the Committee of Accounts shall, at their next monthly Meeting, inspect such demands, and report upon them to the Society, when the Bills recommended for payment, upon such recommendation being confirmed by the Society, shall be discharged at the ensuing monthly Meeting of the Committee of Accounts, by the joint Drafts of the Chairmen on the Society's Banker, or by the money remaining in the Secretary's hands, if the respective sums do not amount to £. 5.

N. B. To persons inclined to leave a sum of money to this Society by will, the following form is offered for that purpose:

ITEM, I give and bequeath unto A B and C D, the sum of upon condition, and to the intent, that they, or one of them, do pay the same to the Collector, for the time being, of a Society in London, who now call themselves, *The Society for the Encouragement of Arts, Manufactures, and Commerce;* which said sum of I will and desire may be paid out of my personal estate, and applied towards carrying on the laudable designs of the said Society.

# (A) BALLOTING LIST.

## PRESENT OFFICERS.

PRESIDENT.

His Royal Highness Augustus Frederick, Duke of Sussex, K.G. and K.C.B.

VICE-PRESIDENTS.

John, Duke of Bedford, F.A.S.
Hugh, Duke of Northumberland, F.R. and A.S.
G. G. L. Marquis of Stafford, K.G.
Jacob, Earl of Radnor, F.R. and A.S.
Robert, Earl of Liverpool, F.R.S.
Charles, Earl of Romney, F.R.S.
Sir Robert Peel, Bart., M.P.
Sir Watkin Lewes, Knt.
Sir Nathaniel Conant, Knt.
Thomas Pitt, Esq., F.A.S.
Richard Clark, Esq., Chamberlain, F.A.S.
Richard Powell, M. D.
John Christian Curwen, Esq., M.P.
Richard Wilson, Esq., F.A.S.
Joseph Hume, Esq., M.P. F.R.S.
William Tooke, Esq., F.R.S.

SECRETARY, Arthur Aikin, F.L.S. &c.
ASSISTANT SECRETARY, Mr. Thomas Woodfall.
HOUSEKEEPER, Miss A. B. Cockings.
COLLECTOR, Mr. William Harrison.

## PROPOSED OFFICERS.

PRESIDENT.

SECRETARY.
ASSISTANT-SECRETARY.
HOUSEKEEPER.
COLLECTOR.

PAPERS referred to.

# (B) BALLOTING LIST.

| PRESENT CHAIRMEN. | PROPOSED CHAIRMEN. |
|---|---|
| COMMITTEE OF ACCOUNTS. | COMMITTEE OF ACCOUNTS. |
| CORRESPONDENCE & PAPERS. | CORRESPONDENCE & PAPERS. |
| POLITE ARTS. | POLITE ARTS. |
| AGRICULTURE. | AGRICULTURE. |
| MANUFACTURES. | MANUFACTURES. |
| MECHANICS. | MECHANICS. |
| CHEMISTRY. | CHEMISTRY. |
| COLONIES AND TRADE. | COLONIES AND TRADE. |
| MISCELLANEOUS MATTERS. | MISCELLANEOUS MATTERS. |

(BB)

No. 18

RECEIVED of
the sum of being his
Contribution to the *Society for the Encouragement of Arts, Manufactures, and Commerce,* for one year from

£. VICE-PRESIDENT.

---

No. 18

RECEIVED of
the sum of being his
Life Contribution to the *Society for the Encouragement of Arts, Manufactures, and Commerce.*

£. VICE-PRESIDENT.

---

SIR; (C)

I AM directed to inform you, that your Annual Subscription of has been in arrear since the day of and as it is of consequence for the Society to know what sums of money they can bestow in Premiums, you are requested to order the payment of it.

By order of the Society,
COLLECTOR.

(D)

SIR; Adelphi,

I HAVE the honour to acquaint you, that on this day you were elected a Member of the *Society for the Encouragement of Arts, Manufactures, and Commerce;* and as, by their Rules and Orders, every person on his election is to pay his Subscription-Money, and is not confirmed a Member till such Subscription be paid, you are requested to order the said payment to be made to the Collector.

I am,
Sir,
Your very humble servant,

SECRETARY.

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Printed by Order,
ARTHUR AIKIN, F.L.S. SEC.

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*** *The Annual Dinner of the Society will take place on the Second Tuesday in May.*

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# ERRATA TO VOLUME XXXV.

The Description of Mr. James Jones's Self-adjusting Crane (p. 141), having been printed from an imperfect Copy, requires the following Corrections:

*Page* 144, *line* 7 from the bottom, after *if*, insert *in*.
—— 145, — 2, for, of *d*, read, *f d*.
— 7, from the bottom, insert a period ( . ) after *E F*.
— 12, from the bottom, for *b b*, read, *l l*.
—— 146, — 19, after, *amounting to a*, insert, *considerable portion of a*.
—— 147, — 18, for *a d c*, read, *a d e*.
— 19, after, *angle*, insert, *e d b*, that is the angle.
— 24, for *a d c*, read, *a d e*.
—— 148, — 14, from the bottom, after, *other*, insert a period ( . )
—— 149, — 2, from the bottom, inclose *more plainly seen in fig. 5*, in a parenthesis ( ).
—— 151, — 8, from the bottom, for *approbation*, read, *application*

# REPORT, &c.

ON THE MODE OF

# Preventing the Forgery

OF

# BANK NOTES.

# REPORT

## OF THE COMMITTEE OF THE

# SOCIETY OF ARTS, &c.

TOGETHER WITH THE

## APPROVED COMMUNICATIONS

AND

## EVIDENCE UPON THE SAME,

RELATIVE TO THE MODE OF

# Preventing the Forgery

OF

# BANK NOTES.

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*Printed by Order of the Society.*

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*LONDON:*

1819.

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IN THE ADELPHI;
AND BY ALL BOOKSELLERS.

[*Price Four Shillings.*]

T. C. Hansard, Printer,
Peterboro' Court,
Fleet Street, London.

# REPORT.

THE rapid increase, during the last three or four years, of convictions before the criminal courts for the circulation of Forgeries of the Bank of England Notes, is such as to have made a very serious impression on the public mind.

The increasing reluctance of Juries to visit with the extreme penalty of the law, a crime, for the prevention of which no successful precautions have apparently been taken, and the notorious fact, corroborated by evidence produced at several recent trials, that Forged Notes have passed undetected through the scrutiny of the Bank Inspectors, have attracted general attention.

Under these circumstances, the Members of the Society for the Encouragement of Arts, Manufactures, and Commerce, have thought it neither unworthy of, nor foreign to the objects for which they are associated, to enter upon an investigation for the purpose of ascertaining whether there exist any means, within the compass of the fine and the mechanical arts, not of totally preventing the Forgery of Bank Notes (for that is obviously impossible), but of increasing the difficulty of imitation, and thus of

checking the prevalence of the crime. With this view, early in last March they accepted a communication from Mr. B. Beaumont, one of their members, and appointed a Committee for its investigation. Other plans from various quarters were sent in, and information of no trifling value was obtained by oral testimony, both from the members of the Society and from strangers.

It is evident that the currency of lowest denomination, whether that be metallic coin or promissory paper, must be that which circulates chiefly among the lower classes, and for the payment of small sums. When it is considered, however, that a large proportion of the lower ranks of society are wholly incompetent, from their ignorance, of distinguishing between two specimens of writing-engraving, that bear only a very general resemblance to each other, it cannot be doubted that the difficulty of protecting these from being imposed upon by Forged Notes is very great.

If the chance of detection increases with the increase of the number of hands concerned in producing a Forged Note (which seems to be generally admitted), then, the best way of insuring the integrity of the circulating medium is, to render necessary for its production the concurrence of several arts, and which it is impossible for one individual to possess.

The component parts of a Bank Note are the Ink, the

Paper, and the Characters of whatever kind, whether letters, figures, or vignettes, that are impressed, by means of the ink, on the surface of the paper.

The perfection of Ink, and that which distinguishes the superior from the inferior kinds is, its absolute blackness, without any intermixture of brown. In this respect the Bank of England Note seems to be nearly perfect; and on comparing the genuine with the spurious, a sensible difference may often be observed.

With regard to the Paper, it should unite in a high degree the qualities of thinness and lightness, with opacity and toughness. On this head, no improvements appear to have been suggested in the Committee, and it is well known that bankers' clerks and others who are in the habit of turning over great multitudes of Notes, will, from the feel alone, separate, with remarkable accuracy, the real from the false. To persons, however, through whose hands multitudes of Notes do not pass, slight differences in the texture of the paper are imperceptible.

The water-mark of the Bank of England Note is guarded from imitation by the penalties of the law; and therefore the forger who buys his paper must necessarily imitate the water-mark as well as the engraving and signature. There appears, however, to be no difficulty in producing a passable imitation of this; and a person capable of copying the engraving, would also be perfectly

adequate to the imitation of the water-mark. The employment of striped paper of different colours was suggested by the author of one of the communications, and although this proposal did not meet with the approbation of the Committee, yet it may be possible to introduce such differences in the compass of a Note, not in the thinness of the paper, but in its actual texture, as to compel the forger to make his own paper.

The face of the present Bank of England Note consists of writing-engraving and a vignette, executed in the usual way on copper, and of certain figures and letters impressed by projecting types, like common printing or wood engraving.

Concerning the quality of the writing-engraving, there was some difference in the opinions given before the Committee by professional persons; the greater number considering it of inferior execution, while by some it was regarded as of fair average quality. Concerning the vignette no difference of opinion subsisted, it being universally considered as offering but little difficulty to the forger.

It is self-evident that, in proportion to the talent employed in the original designing and engraving of a Bank Note, will be the difficulty of imitating it; and abundance of evidence was produced by Mr. Warren, Mr. Ashby, Mr. Sylvester, Mr. Finden, and other artists, that those

country Banks that have chosen to go to the expense even of small vignettes well executed, have never as yet been forged upon, and that a forgery on the Plymouth Bank about 25 years ago, was immediately and effectually stopped by the adoption of a good vignette of small size.

There is, however, a natural limit to the employment of superior engraving, arising from its expense, and from the longer time required for its execution.

It is in evidence that the average number of copies taken from each copper plate, does not much exceed 6,000; hence, if the expense of engraving was greatly enhanced, the profit arising from the issue of £.1 notes would entirely cease. If the daily issue of small notes from the Bank of England amounts to 30,000,—and from the evidence produced, there is reason to believe that it exceeds rather than falls short of this number,—there is a daily consumption of five plates, or 1,500 in the year; and there might, perhaps, be some difficulty in finding a sufficient number of superior artists to produce the required quantity of plates.

The possibility of substituting steel for copper, has been suggested as a means of obviating these difficulties.

A specimen of engraving executed on soft steel was produced to the committee by Mr. Warren, and from the concurrent testimony of several witnesses, it appears that

a block or plate of steel may be softened, so as to admit of its being engraved upon and etched, and that the time required by the artist to produce a given effect is not twice that required when copper is made use of. Under such circumstances, the plate, when finished, would be capable of being again hardened, and in that state will afford 20, or perhaps 30 times the number of impressions that copper will. Hence it appears, that all the security attainable by the employment of art of a very high degree, superior even to that which has been found effectual with regard to the country Banks, is within the reach of the Bank of England, and probably without any additional expense. As examples of the precautions against Forgery, adopted by many banking companies in the United States, specimens were presented, by various persons, of Notes, the margins of which were composed of waved and intricate patterns; these were pronounced by the artists present to be scarcely, if at all, imitable by the common process of engraving.

It was represented to the Committee by Mr. Clymer, who stated himself as speaking from his own personal knowledge, gained while he was one of a company in the United States for the manufacture of Bank Notes, that the engraving of the ornamental borders of the American Bank Notes is made on thick plates of soft steel, by means of the turning-engine, and the punches and other methods employed by die engravers. These plates being subsequently hardened, are used to impress cylinders of soft

steel, and these cylinders, when hardened, are used to impress copper-plates, in which the writing, vignettes, &c., are subsequently inserted in the usual way.

Thus, the absolute identity of almost an infinite number of Notes (scarcely imitable by engraving, as far as the ornamental border is concerned) appears to be provided for, requiring also a large and expensive apparatus for their original production, and therefore impossible of acquisition by the forger, unless previously possessed of a considerable capital.

Specimens of engraving by machinery have also been laid before the Society as applicable to the construction of Bank Notes difficult of imitation; and this part of the subject naturally arranges itself under two heads.

Under the first are included all those methods of scroll work, and of rose engine work, which, from their intricacy, set all imitation by manual engraving at defiance. In some of these instruments, the adjustment admits of so much variety, that even allowing the forger to be possessed of a similar engine, the chances against his hitting on the several adjustments requisite to produce any particular pattern, are almost infinite. Specimens of this kind in particular were presented by Mr. Desvignes. It appears by the application of machines of this construction, that great, and probably almost insuperable, difficulties are opposed to the exact imitation of patterns thus produced. But it

may admit of a doubt whether their very intricacy, and the want of any prominent part to impress the attention, would not allow even a general resemblance to pass in the hurry of business.

The second kind of machine engraving differs essentially from that just described, in the perfect uniformity of its work.

It therefore consists of straight or waved or curved lines, placed exactly parallel to, or intersecting each other at regular distances, producing the general effect of a tint of even colour over every part covered by the engraving, and characterised, on minute inspection, by an exactness in the relative situation of the lines wholly unattainable by hand. Specimens laid before the Committee by Mr. Allan and by Mr. Solly, seem to leave little, if any thing, farther to be desired on this head.

Another art, namely, that of typographic printing, has been introduced into an American Note, and is also the subject of a communication by Mr. T. C. Hansard, approved by the Committee, and by the Society.

From the testimony of professional artists, it appears extremely difficult to produce the effect of type printing by common engraving. If, therefore, it be granted that a note composed of type can only adequately be imitated by type, the present forgers must either associate type

makers in their schemes, or learn an entirely new art. The smallest kind of type, called *Diamond*, is so difficult of execution, and so little in demand, that (as appears from the testimony of Mr. Caslon) there are not more than four or five persons in England who can cut the punches for it. By fixing upon an unusual form for the type, in which, for example, the letters shall lean the contrary way to Italic type, and making it penal to execute any such, except for the Bank of England, a great difficulty in the first instance will be opposed to the Forger. It does not appear that the most expert artist can execute more than two punches in a day. Now, it would be easy to combine 1,200 or 1,500 different letters and characters, and forms of letters and characters in one Note, and to repeat each letter and character several times.

It would therefore be necessary that the forger should either be himself a first-rate artist, or should secure the co-operation of such; and that he should employ from two to three years in furnishing himself with materials. That he then should acquire the art of the letter-founder, or expose himself to the additional risk of a second associate in his fraud, in order to obtain from the punches a font of types.

But security in a high degree against Forgery is not the only advantage attending the use of typography; for if with this latter the process of stereotyping be combined, we obtain absolute identity through an infinite number

of impressions, without any necessity of renewing the original punches, combined with all the difference in rapidity of production between letter-press and copper-plate printing.

It appears, therefore, as the result of this Investigation, that there are at least three or four practical methods of constructing Bank Notes, each of which will, in a greater or less degree, prevent the successful competition of the Forger; namely, the highest perfection of design and of engraving, executed on steel,—the adoption of figured borders, like the American Notes,—the union of variety, evenness, and mathematical accuracy, in engine engraving,—and the perfection of type combined with stereotype.

But the employment of any one of the three first of these modes is not in the least incompatible with the combination of any other or of all the three; and this combination is in fact contemplated by the authors of all those communications that have been approved by the Society.

In the same manner analogous combinations of wood engraving, and of works of art cut in the same manner, or struck on metal, are capable of being united with printing type.

Thus means appear to be accessible to the Bank of

England, of rendering the forgery of their notes in a high degree more difficult than at present.

The problem entrusted by the Society to the investigation of this Committee, appears to be resolved, and although it is not in the nature of things that a person who cannot read should be protected from imposition by the most clumsy forgery, yet to all others the security thus offered appears to be so nearly complete, as to invite a fair trial of its practicability.

# COMMUNICATIONS.

## MR. T. B. BEAUMONT'S COMMUNICATION.

County Fire Office, Southampton Street,
March 4, 1818.

To His Royal Highness the PRESIDENT and the Right Honourable and Honourable the Officers and Members of the Society for the Encouragement of Arts, Manufactures, and Commerce of London.

MAY IT PLEASE YOUR ROYAL HIGHNESS,
MY LORDS, AND GENTLEMEN;

FORGERIES of Bank of England Notes are so frequent, and the consequent loss to the public, and hindrance to commerce, and sacrifice of human lives to the penalties of the law, are so considerable, that I think it high time for persons of intelligence and influence to exert themselves for the prevention of the evils. This, I am well persuaded, is attainable in a very considerable degree, if not wholly so. But, in addressing the Society of Arts, I appeal to a body of gentlemen who are qualified to be the best judges on the subject, and I am desirous that my opinion should be corrected by their's.

I therefore take the liberty to submit an extract from a paper, which, about a year since, I sent to the Bank of England, on the prevention of Forgeries. It is only within these few weeks that I have had an answer from the Bank, and this informs me that similar plans to mine had been received from others, but that none were deemed effectual.

If, however, a succession of persons, who are known as men of science or business, suggest similar means of prevention, the reasonable inference, I submit, is, that opinions so concurring are right.

I have the honour,

&c. &c. &c.

J. T. Barber Beaumont.

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*Extract from a Paper delivered by J. T. Barber Beaumont, Esq., to the Bank of England.*

Forgeries of Bank of England Notes are so frequent, because they are so easy of imitation. They are of inferior workmanship to common engraved shop-bills. An apprentice to a writing engraver of two years standing, by three or four days work, is able to copy a Bank Note plate, so that ordinary judges cannot tell the genuine from the spurious. There are not less than 10,000 persons in this country who are able to engrave successful imitations of Bank of England Notes, and nine-tenths of these are in needy, and many of them in distressed circumstances. It is, therefore, not surprising, if amongst so many who are competent to relieve their necessities by these forgeries, some should be desperate enough to commit them.

Now if, instead of being the common-place work of *inferior writing engravers (who are so numerous)*, Bank Note plates were *master-pieces* of the *best historical engravers (who are so few)*, whose talent is so rarely to be found, the number of persons who would be able to attempt an imitation, with any chance of success, would be very inconsiderable indeed—not ten persons, perhaps, where there are now ten thousand. But these persons, by the legitimate use of their talents, can acquire compe-

tence—they, therefore, are not likely to employ their time, and risk their lives in felonious imitations. Nay, if in the perversity of the human mind, a first rate artist were disposed to turn forger, he could not do it successfully, because, even in the very first rank of historical engravers, one cannot imitate the engraving of another in a work of importance, such as an historical group finished in the best style, without the difference of manner being visible. If, for instance, Sharp were employed to engrave a plate, and Heath or Warren (I hope those gentlemen will pardon the supposition) were disposed to imitate it, they might produce a work of similar beauty and general effect to that of Sharp's, but the difference of manner would be obvious to the commonest observer, and not only would the forgery be instantly detected, but the hand that had done it be immediately identified—for historical engravers recognize each other's handling with as much facility as correspondents recognize each other's handwriting; and with more certainty. It is, therefore, not within the verge of probability to suppose that first-rate artists, enjoying large incomes, would commit a crime, where defeat, detection, and punishment, could not fail to light on them immediately; and as none but first-rate artists could make the attempt, it follows that an end would be put to the commission of the crime.

This view does not rest upon theoretical reasoning. It has been proved to be true in practice. Several Country Bankers have long been aware of the utility of having their notes engraved in a superior manner, in order to increase the difficulty of imitation. They have had their notes engraved in this manner, and have succeeded completely. I might quote several instances of the success which has followed this precaution, but this may suffice: The proprietors of the Plymouth Dock Bank, about 18 years since, were forged upon: they, in consequence, had

a handsome vignette designed, and engraved by an eminent historical engraver. He has engraved several successive plates for them, and they have never been imitated. But the partners, some years since, wishing to have a distinct appearance between their *notes* and *bills*, had a new plate engraved for the latter, with only an *ornamental cypher* instead of the vignette. This was *no sooner issued than it was imitated*, whereupon they immediately discontinued the use of the cypher plate, and adopted the vignette, and *since then* they have had *no forgeries on them*. The artist tells me that he and other historical engravers have engraved vignettes for several Country Bankers, and that he never heard of a Forgery having been ATTEMPTED of any of *their* plates. Thus the feasibility of the system in theory stands confirmed by practical experience. Its effectiveness then in the prevention of Forgeries, I think, cannot admit of a doubt. The only reasonable objection which I can conceive it possible to advance, lies in the seemingly great expense of using *superior historical engravings*, instead of *inferior writing plates*. If, however, I shall prove, that instead of the proposed means involving the Bank in additional expense, it will materially lessen the expenses, at the same time that it will relieve the public from the loss of time occasioned by writing names on the notes, the loss of property incident to their receiving forged notes, and the vexatious proceedings consequent on their being impounded by the Bank, to say nothing here of the temptation to crime, and the sacrifice of lives consequent on the present mode of manufacturing Bank Notes—I think it will be impossible to deem the system which I advocate otherwise than highly useful to the Bank, as well as to the public, and such as ought to be adopted without delay. Now then as to expense.

It is well known that engraving may be done upon softened steel as well as on copper; it is also ascertained

that when engraved, the steel plates may be hardened to a high degree, without injury, and that, so prepared, they will yield an immense number of impressions without any sensible wearing. I have heard some practical men say, they will bear a million of impressions, others reckon upon a hundred thousand. A plate executed, as I propose, would cost £.30; so that taking the minimum of impressions, viz., 100,000, the expense of using fine historical engravings on steel, would be £.30 for 100,000 impressions.

The present copper plates, I suppose, cost the Bank about £.3 each, and yield about 5,000 impressions; the expense then of using bad writing engravings on copper, is £.60 for 100,000 impressions, just double the expense of plates on the preventive system. This view only draws into comparison the relative expenses of the opposite description of engravings, but a far more important saving would be produced by superseding the necessity of the expense of criminal prosecutions, and of the attendant corps of spies and informers.

A further effect of this system in preventing forgeries, would be found in all the Notes of one kind for a *long period of years* being taken from *one plate*, whence a person having a genuine Note might compare it with the *minutiæ* of another suspected to be forged, and as it would be impossible even for the artist himself who had engraven an original plate, to follow, in a copy, the length, sweep, depth, and number of the strokes in his original, a detection would be easily made, even by those who knew nothing of the arts.

My preventive of forgeries, then, consists in *combining* the use of the *finest historical engravings* with the use of *plates of extraordinary durability*.

The vignette which I should recommend for the plates of the Bank of England, would occupy not less than one-

third of their whole space. It would be an historical composition—containing not less than three human figures; the figures to be nearly naked, as such subjects put the ability of the artist to the nicest test. The very first-rate talents to be found among the artists of this country ought to be enlisted in this service. Different vignettes ought to be used for the different denominations of Notes, the more effectually to distinguish them. Every successive plate of one denomination should be marked with a successive letter or number, and the date of the year when first issued.

Such is my conviction of the effectiveness of the system which I recommend, that I am willing, at my own expense, to produce such a plate, as I have described, and a hundred thousand impressions from it, provided the Bank of England will adopt the plan.

Should this proposal be accepted, it would be necessary for me to submit designs of the proposed vignettes, and to confer on the best mode of filling up the writing part of the plate, and of guarding the finishing of the plate, and the taking off of the impressions, so as to preclude the possibility of a misuse of it.

*Postscript.*—Although I dwell upon the combination of the finest historical engravings, with plates of extraordinary durability, as affording the surest means of preventing Forgeries, I do not propose that these should be used to the exclusion or neglect of any other means which can conveniently be added to increase the difficulty of imitation. I therefore recommend that the best workmanship in the department of Writing-engraving should be introduced, that a stamp from a die of superior execution should also appear; that curious engraving of converging, and undulating lines, such as can only be produced by a very expensive engine, should be further introduced; that a wood-cut of landscape and figures, and engine-

work, executed in the best, and most difficult style, should be printed on the back of the Note; that the paper in its texture and substance, should be essentially different from any other paper (singularity in the water-marks alone, is not sufficient). By thus combining excellence in different arts, the attempt of imitation can only be made by an association of the most eminent professors in those different arts, together with an advance of capital, which, I believe, men who commit Forgeries are never known to possess.

B. B.

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*Additional Observations.*

But if it be supposed that superior engravings will be of no avail, because an inferior artist might make an imitation, although a bad one, and that the public generally would not know a bad copy from a fine original, I would submit the following reasons to the contrary.

To make even a bad imitation of a fine historical vignette, the forger must be an experienced engraver. The present Bank of England Notes are forged by prentice boys, prisoners, &c., and may be, by any one who can use a camel's hair pencil.

Every engraver must be sensible of the difference there must be between his copy and a fine original, and as he would have to fear that the first person into whose hands his imitation chanced to fall might possess sufficient discrimination to see the difference, and detect him, he would be discouraged from making the attempt.

He would be further discouraged by the time and labour that it would consume to copy a fine historical group.

And the public are not so insensible of talent in the arts as is often supposed. Publishers are well aware of

the interest which the multitude take in a well-executed print, and, therefore, give a high price to superior engravers for embellishments to cheap editions of plays and novels. They would not go to this expense, if the public were insensible to the difference between good and bad engraving.

A similar interest would be excited toward a picture on a Bank Note, if the subject were pleasing, and the execution fine.

And a person thus interested in the picture on a Bank Note, and accustomed to view it, could scarcely fail to be struck with the difference that would appear in a copy by an inferior artist, although such person might have no skill in the arts.

His suspicions excited, he would examine and compare the suspected Note with a corresponding genuine Note, and detect the difference, or refer to some neighbour of taste, who would solve his difficulty.

Thus the public would very generally be able to defend themselves against the intrusion of a forgery.

But, because some might be so stupid or ignorant as not to be sensible of the difference between a fine original and a bad copy, surely that is no reason why others of better judgment should be precluded from the means of protecting themselves. As Bank of England Notes are now made, the enlightened and the ignorant are equally disqualified from judging between an original and a copy. If a master-piece of art be introduced into their composition, the means of judging will be supplied; and here I may be excused in observing, that a judgment in the arts being rendered thus daily useful, will go far toward improving the taste of the public in this country.

The objection that hardened steel plates cannot be produced in a sufficient quantity to supply the consumption of the Bank, I do not believe to be well-founded.

Copper plates are producible in sufficient numbers, and a hundred of these are necessary, where one steel plate might suffice. But superior historical engravings are to be introduced on the steel plates, and first-rate historical engravers are but few. To determine accurately how far the whole demand of the Bank may be supplied with historical engravings, we are in want of information as to the number of new Notes, of each denomination, which the Bank issues in a given time. But this information is kept a secret. We are constrained, therefore, to guess at it, and suppose that half a million of one pound Notes are issued in a month. Now, we are assured that the steel plates will stand double that quantity. But if a new plate were required every month, a single historical engraver would have no difficulty in supplying it.

If, however, it turns out that the issue of one pound Notes exceeds the number supposed, and that the steel plates will not last so long as is stated, and, therefore, that fine historical engravings on steel are not applicable to *one pound Notes*, of which the issue is so very considerable, that part of my plan may be abandoned as far as regards one pound Notes. The remaining six, out of the seven arts proposed, may still constitute a sufficient security. But considering fine historical engraving to be the surest test, I would retain it wherever I could; and as all the Notes of a higher denomination than one pound are issued to a small amount, comparatively, the vignettes may be introduced into them without doubt or difficulty, and the security to the public be rendered perfect as the value of the notes ascends.

Thus, a combination of seven superior artists, in separate and distinct branches of the arts, would be necessary to produce an imitation of a Bank Note on my plan, viz.

A first-rate Historical engraver.
Writing engraver.
Rose and other engine engraver.
Die sinker.
Engraver on wood.
Turner on wood.
Paper maker.

But forgeries of Bank Notes are usually committed by inferior and necessitous men, or prentice boys. It is not within the verge of reason to suppose that seven first-rate professors, in distinct branches of the arts, would combine for the purpose of committing forgeries, and more particularly so, as the attempt could only be made at a great expense of time and money; and, after all, could not escape speedy, if not immediate detection.

## MR. T. C. HANSARD'S COMMUNICATION.

### MEMOIR ON THE BEST METHOD FOR PREVENTING FORGERY OF BANK NOTES.

Peterborough-Court, Fleet-Street,
April 18, 1818.

ALL who have given any attention to this subject, so highly important to the pecuniary interests of the Bank of England, and the English nation, and so imperiously called for by every dictate of humanity, agree in the necessity of forming the BANK OF ENGLAND'S NOTES, which constitute so great a portion of the legal currency of the country, by such an union of talent in the various arts most applicable to the purpose as would render the imitation so difficult, that although not a matter of absolute impossibility, yet that it should require such an unprecedented union of talent in the same person (for forgeries are rarely executed by partners in the crime), and so great a sacrifice of labour, time, and expense, before a single imitation could be effected, as would place the success of any forgery, the farthest possible from all probability. Upon this principle, I beg leave to lay before the Society, of which I have the honour to be a member, a PLAN for a BANK NOTE, possessing, as I conceive, every requisite above stated; and which will, at the same time, be, when once formed, capable of a very rapid production, at a trifling expense.

Many plans of engraved Notes may be suggested, which

would produce a work highly creditable to the Arts and Artists of this country, the imitation of which, by any inferior artist, should be impossible; but still, being within the possibility of counterfeit by the effort of a single hand of superior skill, it might sooner or later be attempted; and when effected, the evil would be increased in proportion to the confidence against fraud, which the execution of the original had given to the country.

My plan will embrace the labours and skill of several artists, each in so difficult and different a branch of art, as to require the study and practice of many of the best years of a man's life before he is competent to execute the finer parts of his profession. The various arts will be wholly distinct, in practice, from each other, and will be proved to be so various and complicated, that, twenty at least being named, no man ever could, or at least, ever did, unite the capability of executing any three of them in his own person. Next, the time and expense necessary to the producing the first One Pound Note on this plan, would be so great, as to put it out of the power of those likely to be engaged in such a crime (even supposing they could employ the requisite artists for the undertaking, and keep them to secrecy) to embark in such a concern; and if even the possibility of an imitation on copper or wood, were granted, it could be done but at the expense of so much time and talent, as would be an effectual bar to the attempt; and even to go farther, and grant it were once effected, the power of pointing out the means of detection in the most minute point or variation, and also of defeating the whole attempt by one of the many changes which in my proposed note a few weeks or days might effect, would complete the security from any attempt at imitation and forgery.

Nothing can offer all these advantages but the perfection of a TYPOGRAPHIC NOTE, arranged, by that art, in

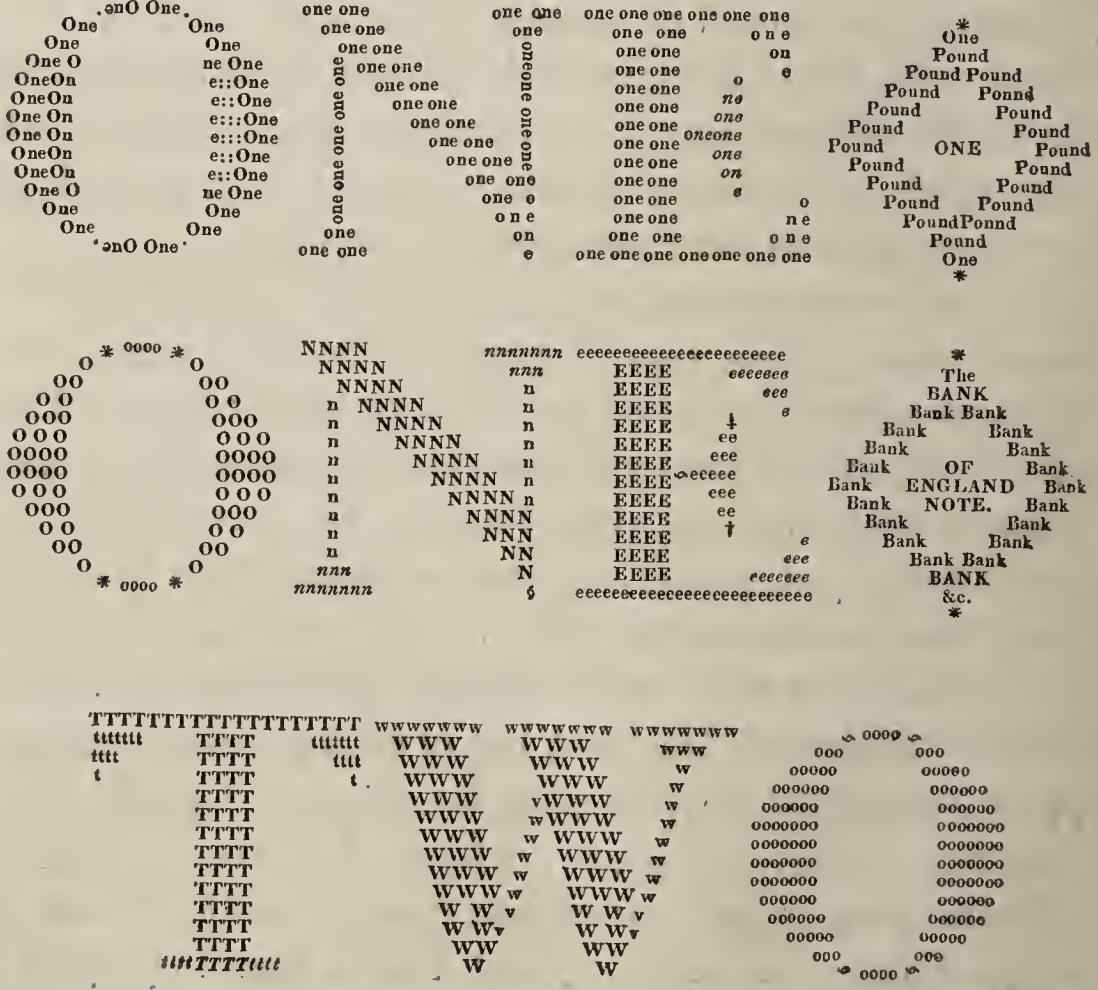
all its nicest forms, with the help of those auxiliary arts with which it may be advantageously combined. And first, the *Chalcographic Art*, to execute from approved designs, four medallions or figures to be cut on blocks of wood, brass, or steel, to give a surface impression, as in the manner of type: and as I would preserve, wherever it is consistent with my design, any part of the form or feature of the present Bank Note, I would have at each top-corner of my note a figure of Britannia, like that now used by the Bank, as their emblem, which might be a *fac simile* of that on the present Notes, having *black* and shaded lines on a *white* ground; below each of these, at each side of the Note, I would have a figure engraved in the contrary style, viz., the figure *white* upon a *black* ground: (example)—on one side an allegorical representation of Liberty, on the other Justice. In continuation of the engraver's art, the centre square to contain a border of exquisite design and workmanship, within which should be contained the usual words of the Bank note, from a design of some eminent writing-engraver in all the various styles of ornamental penmanship which the space will admit; this to be executed on a block of brass or steel, as the figures before proposed.

I shall next speak of the *Typographic* art, and its relative assistants. With type I propose the top, sides, and bottom compartments of the Note to be filled up. This would require the joint and particular labours of the punch-cutter, matrix-maker, type-founder (in several of its branches), and printer, neither of whom can possibly execute the work of the other. The type to be cut on purpose; to be very small, at least equal in minuteness to that denominated *Diamond*, but of such peculiar form and proportions that it could never be required for any other occasion to have the same. I have two forms to suggest for this purpose, and for each of these forms three kinds of type, giving six varieties; and I have then to propose a

type of an entire new appearance on paper, so novel that any legal security might be obtained for it: this would admit of the same changes as the former, and thus give twelve kinds of type, all of the same size, and the English character, and every letter and point of each to be plainly read and understood by any person whatever. The last proposed six forms would render imitation on copper a thousand times more difficult and require additional exertion of skill in the founder and printer.

These preliminary arrangements being complete, the mode of application must be next described.

The top compartment of the note, between the figures of Britannia, to exhibit in letters of about an inch in size the value of the Note, but these letters to be formed by the display, in various ways, of the small Diamond type before described, thus:



or varying one of the words, or the letters, or the lozenge, to the word *Pound*, or any other word; or the whole space might be formed of continuous lines of type, in which the portions necessary to form the large words might be of type of a different face, either lighter or darker in appearance, so that at a little distance from the eye the effect would be of the words One, &c. being dark upon a light ground, or light upon a dark ground; the bottom, and even sides, of the Note to be filled up by the same means and devices. To form the subject of the long, or shade lines, I would have a syllabus of the law either existing or which may exist, relative to the securities against Forgery; it should be made highly penal for any *Punch-cutter*, or other person to devise, cut, make or possess; or *Founder*, to justify, strike, cast, dress, or have or deliver; or *Printer* to have or use, such [described] type, being less in body or face than [Pica];—or any *Engraver*, &c. to draw, trace, engrave, cut, or otherwise form or imitate, or have in possession, &c. &c. I would not propose any general prohibition against such kind of type as may be chosen, lest any opposition should be made against "fettering trade," &c. and therefore only prohibit below such a size as never could answer any purpose for a Bank or Banker's Note; and above all I would have frequent repetition of the warning given upon the French assignats, and I believe present Bank Notes, by which the attempter of forgery should be reminded of his crime, and copy his own condemnation. "*The Law punishes with Death the Forger.*"—"*The Law rewards the Informer to prevent the Crime.*"

The whole of the type and vignette devices being completed, they will have to be formed together, as a complete Note, by the printer; to be proved, till finally approved, and then to go into the hands of the stereotyper for moulding and casting any number of fac-similes which may be re-

quired, preparatory to being ready for printing off: this would depend upon the possibility of size to which the Bank Note paper could be manufactured; if no objection arose on that score, twenty Notes might very well be given at one impression, which at 100 impressions per hour, and 10 hours per day, will, with two men, yield 20,000 in one day, in the manner of fine work; in the ordinary mode they would produce from 30 to 40 thousand.

It will now be necessary to particularise the various artists and workmen, to show through how many hands and processes the whole must pass before arriving at maturity.

Ist, The *Graphic* art will require the Designer and *Engraver;* but as a comparison of possibilities of imitation must be kept sight of throughout, I shall only enumerate—1, the ENGRAVER. The number of artists excelling in wood-engraving (in brass or steel they are still more rare), is, in comparison of copper-plate engravers, probably as 1 to 100.

II. The various arts immediately necessary to form the typographic part—thus: 2ndly of the PUNCH-CUTTER. This is the most difficult and confined art; not more than four or five artists could be found in this kingdom capable of cutting the punches for a Diamond type, nor so many to execute it in conjunction with any difficult plan. The works of one artist in this line are as well known from those of another, as in plate engraving. I know of but three sets of Diamond punches in England; each is distinguishable by a common eye, and by the profession known by whom cut, or rather cast; as the letter-founder is, invariably, the employer of the punch-cutter. The number of punches necessary to complete a *fount*, or every sort used, is very great; an ordinary fount requires about 226; by the addition I first propose, I add 66=292; if both my peculiar sorts are adopted, it would double that

number, making 584; and if the last proposed new kind is also chosen, it will double again—1168: thus near 1,200 punches would be required. An artist of the greatest industry could not cut more than two in a day. After they are completed for the ordinary number of 226, it will take a founder six months in matrix-making, justifying, mould making, casting, dressing, &c. before he could deliver any thing complete for printing; but it should be remarked, that these materials being once perfected, are of everlasting duration, admitting of all the infinitude of change that twelve kinds of type (like the changes upon twelve musical notes) are capable of.

In the LETTER-FOUNDER'S Department,

III. The *Justifier* also strikes the matrices into copper, by the punches. This is no part of the punch-cutter's art, it is confined to the founder himself, or his manager.

IV. The *Mould-maker*, also a separate branch of the founder's business; and as I should propose, in order to render the type almost useless in case of fraud, a mode of making it which would be different from the usual mould, that would afford an additional security.

V. The *Caster*—a separate department in the foundery, even the best of whom (and none but the choicest casters can be employed on Diamond, or small type) is incapable of the other departments.

VI, VII, VIII, IX, X—*Breaker-off, Rubber, Kerner, Setter-up, Dresser*; all various and separate departments in a foundery, no two of which are ever united in the same hand.

XI. The *Printer's Department*, who, to give effect to the whole, must be consulted in the letter-founding department, and therefore of adequate skill and practice in his profession. He will employ

XII. The *Compositor*, who must be of the most skilful class. Considerable difficulty is, by the form proposed,

left for him to overcome. It would be a work of much time and skill to set up the lines and words; no one whose fingers and eyes were unpractised in small type could work immediately on Diamond. The type would have to be, by the nicest skill and patience, united with the centre block engraving, and top and side vignettes; and then to be turned over to the *Pressman*: the printing business is divided into those two departments, and if they are sometimes in practice united in one man's person, it is in the instances of those brought up in houses of little practice, or in provincial towns, and who are never made perfect workmen in either; it appears physically impossible; for the man whose hands have been hardened by working at press, his fingers swelled, and their extremities hardened to the finer sensibilities of touch, would be found incapable of even feeling Diamond types;—it would thus require at least two hands in the printing department. Next would follow the *Stereotyping Department*, for the casting of the stereotype plates. Some printers profess to execute this also; but they must either be men of most unusual acquirements, and as such well known, or masters assisted by men of practice in the moulding, casting, and picking, or engraving; and stereotyping from Diamond type, and the various minute and difficult combinations above proposed would require the utmost exertion of skill and practice—not less than three hands would necessarily be employed in this department.

The next subject for consideration is the Paper; but on this head I cannot conceive any thing wanting in addition to the present manufacture, except as to the size of the sheets to suit the number of Notes determined to be printed at one impression. I have proposed twenty; a less size than double demy would effect this. As to the fabric of the paper, I would leave that just in the state it now is; nothing more fitting for strength and durability (as far as

those qualifications are requisite), or lightness, for convenience and commerce, can be proposed. I decidedly object to the idea of printing on both sides of the Note, because, first, either very thick and opaque paper must be used, or, secondly, the opposite, or backing impressions would so blend into and confuse each other, that neither would be distinctly shown; confusion would ensue, and that beauty and clearness of impression would at once be given up, which would be the best safe-guard against imitation; and thirdly, either the time taken for printing off, or the presses and workmen employed would be at once doubled, and consequently the expense increased in like proportion.

The next art to be proposed to perfect the Note, is that of the DIE-SINKER. I would have a stamp of some excellence after the numbering, dating, and signing are completed. The device might be either the royal British arms, or an elevation of the Bank, with an inscription round it, that no other stamp could ever be mistaken for this; the stamp to be in the centre of the Note.

The machinery and mode at present in use for numbering and dating of Notes should be still used; nothing can be more effectual, excepting that the form of the letters of the writing part should be of much better design than the present.

Thus I would produce a Note, which should, in so many parts, present even to the most ordinary capacity such striking peculiarities, that any attempt at imitation, after a sacrifice of time and expense, out of all probability of ever being devoted to such nefarious purposes, must be instantly detected. The learned and the ignorant might be equal judges, from some of the many parts and peculiarities by which it would be formed; every line, every word, and every letter would have a clear character and definition. Such a *letter*, in such a *word*, in such a *line*, being pointed out as erroneous in an imitation, would at once destroy the whole fabric of the forgery; and all

their work would be to do over again, at just an equal chance of detection. In the diamond type alone there would not be less than 5,000 letters upon each Note, all of which would be capable of being pointed out by this kind of latitude and longitude; and any one or more of which might purposely be made peculiar to serve as private marks, known only to the printer and the Bank, the missing of any one of which by the imitator could be immediately advertised to the whole country, as the sure and easy means of detection.* Imitation by tracing for a block or plate engraving, would be a work of immense labour and the most consummate skill; and if done by the latter mode, no eye could be deceived in the difference of impression on the paper—as to the former mode, it may be safely pronounced as next to impossible. In short, nothing but a co-operation of artists and workmen, equal in number and ability to all I have described, with a vast capital for their time and expenses, could possibly effect a forgery, unless we are willing to suppose a mind capable of uniting the will to do the crime, with such a wonderful share of science, ability, and perseverance, at a sacrifice of many years of study and practice, as will be the nearest possible to an impossibility to be contemplated.

I shall now bring under one view the artists I have before stated as necessary to be engaged in my plan.

1. The designer of, and
2. The engraver of the vignettes, medallions, and writing.

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* *Example of Private Marks.*

In line
6 the word person, observe the R, which is a small capital.
13 . . . shape . . . . ɐ, which is reversed.
39 . . . indifferent . . *d*, which is italic.
44 . . . marks . . . . R, which is a small capital.
101 . . . variety . . . *e*, which is italic.
115 . . . course . . . . *u*, the same.

The uttering a Forged Note, is Felony.

The having a Forged Note in possession, unless defaced, is punished with Transportation.

1819. February 3. **London.** February 3. 1819.

*I promise to pay to Mr.* *or Bearer,*

*on Demand, the Sum of* **One Pound.**

*For the Gov^r and Comp^a of the Bank of England.*

**£. One Pound.** *(Signature.)*

The Law punishes with Death the Forger.

**The Law rewards the Informer in order to prevent the Crime.**

*It is proposed that it may be enacted*, that from the day in which the Statute shall receive the Royal Assent, it shall not be lawful for any *PUNCH-CUTTER* or other Person to devise, cut, or possess any Punches for Type being of the nature or form therein described; nor for any *TYPE-FOUNDER* or other person to strike Mattrices for or to cast, dress, have or deliver any Type of such described form, shape, or fashion; nor for any *PRINTER* to receive, have or use such kind of Type; nor for any Moulder or Caster of *Stereotype* to mould or cast from any such Type: other than such Persons as shall be authorized by the BANK of England to cut Punches for, or to strike Mattrices for, or to cast from such Mattrices, or to compose, print, have in possession or deliver; or to mould, cast from or have in possession any Plate or Plates from any combination in which such Type is used, *&c. &c.*

*Observations.* In looking at this PLAN for a TYPOGRAPHIC BANK NOTE, it must be clearly understood as offering only a general sketch of the Manner and Form proposed. The TYPE to be of a different appearance from this, or any other in use, though not exceeding this in size, and it may be varied to as many as twelve distinct kinds, or faces, all equally legible to be read by the most indifferent capacity; and allowing thus an infinite variety of modes and forms, in the display and arrangement, and capable of any number of private Marks, easily made known to the Country in any possible case of forgery. The Vignettes to be of appropriate design, and fine execution, cut on Brass or Steel. Those at the top corners may be two figures of Britannia, like that on the present Bank Note; those at the sides, allegorical figures of Liberty and Justice. The centre to be a border of chain or other work, executed by Engine-turning on Brass, or of Type device; within which are to be the usual Promissory Words of a Bank Note; the Writing to be in all the various ornamental styles of Penmanship, of exquisite design and execution, upon a Brass Block. This lower part of the Note to contain a Syllabus of the Law necessary to prevent any attempt at Imitation; and other parts to have, in as few words as possible, the condensation of the Statutes for the protection of the Public from Forgery, as a warning by which any attempter at Fraud must read and copy his own condemnation. The present mode of Numbering and Dating to be preserved, and no alteration is proposed as *necessary* in the fabric of the Paper. The previous arrangements being completed, any number of *fac similes* to be taken by means of Stereotyping. The Note is to be completed with a white or dry Stamp (in the very centre) of the Arms of England, or an Elevation of the Bank, surrounded with the words, in very legible characters, BANK OF ENGLAND. The Cost of the first Note on this Plan is estimated at from 1,500 to 2,000 Pounds, and to take from 8 to 12 months in preparation; but after that the production will be so rapid, that with the labour of four Men only, without the assistance of any Steam Machinery, 40,000 Notes may be produced in a Day of the finest Workmanship, at the Expense, including Paper, of Half a Farthing each Note.

The Words here shown below the Note are only for the purpose of exemplifying the manner in which an endless variety of forms may be devised. Upon these Lines it is proposed to form the Letters of the Value of the Note, or any other word (ENGLAND for instance) by inserting a heavier or lighter faced Type, the appearance may thus be made of dark upon a light ground, or light upon a dark ground.

It can scarcely be necessary to observe that the Types, &c. of which this Scheme is composed are such as may be collected in the ordinary course of business;... the Vignettes, some designed for other purposes; and this explanation only serving to fill the space which is to be differently appropriated.

It is most decidedly objectionable to printing on the Reverse of the Note, because first, either very thick and opaque paper must be used; or secondly, the opposing impressions would so blend into and confuse each other that neither would be distinctly shown, confusion would ensue, and that beauty and distinctness of impression would at once be given up which would be so great a safeguard against a bad imitation; and thirdly, either the time taken for Printing off, or the Presses and Workmen must be at once doubled, and consequently Expense increased in the same proportion ... There are upwards of 6000 Types in the above Specimen.

*The Letter-Founding Department.*

1. Punch-cutter.
2. Justifier and matrix-striker.
3. Mould-maker.
4. The caster.
5. Breaker.
6. Rubber.
7. Kerner.
8. Setter-up.
9. Dresser.

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*The Printer's Department.*

1. The compositor.
2. The reader.
3. The pressman.

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*The Stereotyper's Department.*

1. Moulder.
2. Caster.
3. Picker.

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*The Die-Sinker's Department.*

1. The engraver.
2. The engine-maker.

Thus, twenty are enumerated; but, in the usual course of trade, more would be necessarily employed—perhaps, in a case of necessary concealment, some one in each department might execute (but not well), the parts of two;

I shall therefore conclude it to be impracticable, with less than twelve, to be engaged in any attempt at imitation by the same means.

The next subject of inquiry may be, the expense; and were it possible for this to be any consideration in effecting so important an object, it will at once be obviated by my showing that so far from causing any increase of charge to the Bank, a vast saving would be effected, independent of the great reduction of expense under the head of Law Charges and Prosecutions. It will appear enormous to state, that the first One Pound Note, upon this plan, will cost from FIFTEEN-HUNDRED TO TWO-THOUSAND POUNDS, and take at least TWELVE MONTHS in bringing to perfection; but, after that, with the expense of six or seven hundred pounds more, to perfect the presses and other apparatus, the production will be so rapid, and at so little cost, that the savings of a few months will defray the whole expense of the preparations, and then the Notes will be produced at the cost of half a farthing each. In order to give an estimate, I will suppose

| | |
|---|---|
| 1. The designs and engravings of the vignettes to cost | £.100 |
| 2. The punches for the type, about 1,200, @ £.1 | 1,200 |
| 3. The type, about 300 lbs. @ £.1 | 300 |
| 4. Printer | 10 |
| 5. Die sinker | 100 |
| 6. A small proof press | 20 |
| 7. The border, writing engraver, &c. &c. | 100 |
| 8. Contingencies | 50 |
| | £.1,880 |

The further preparations.

| | |
|---|---|
| 1. Materials and utensils for Stereotyping from the first formed Note | £.200 |
| 2. Casting 50 plates | 25 |
| 3. Two presses | 200 |
| 4. Hydraulic press, and glazed boards for smooth-pressing | 200 |
| 5. Fittings up for wetting, drying, cutting, &c. | 100 |
| 6. Contingencies | 25 |
| | £.750 |

Now,

Two presses will produce, at least, 40,000 Notes per day.

| | | | |
|---|---|---|---|
| Four men, @ 10*s.* | 2 | 0 | 0 |
| Paper, 4 rm. @ £.4 | 16 | 0 | 0 |
| Ink, &c. | 1 | 0 | 0 |
| Wetter and dryer | 0 | 5 | 0 |
| Cutter | 0 | 5 | 0 |
| Contingencies | 0 | 10 | 0 |
| Expenses of one day | £.20 | 0 | 0 |

for 40,000 Notes, is HALF A FARTHING each Note.

It will be strictly congruous with the subject of this Memoir, to consider of the precautions which the Bank might adopt in furtherance of the plan now proposed, to prevent, during the progress of preparation, any thing escaping which might lead to fraud. The first process, or punch cutting, might be carried on within the walls of the Bank; but I should think such a confinement unnecessary and inconvenient. The process must be under the inspection and control of the letter founder,—he

alone, from taste and experience, can decide when they are perfect; numerous alterations and re-cuttings take place before a fount is complete. The subsequent processes in the letter founder's department are so multifarious, require so much room, established apparatus, and various preparation, and yet could be so easily secured, that it would be almost impracticable to establish a foundry for so small a purpose; it would be eligible, therefore, to execute the whole of his business in his regular mode, till arrived at the very last stage;—the punches, matrices, mould, &c. &c. might then be delivered to an officer of the Bank; but, from this period, every thing must be done within its own walls. Three or four rooms would be all the space required. The type, compositor, and his apparatus in one room. The stereotyper in another. The presses, which require about eight feet square each, in a third; and the fourth to be appropriated to preparing the paper, and for the hydraulic press, with glazed boards, for the smooth-pressing, when dry;—the drying could be carried on in all the rooms. The presses would be made so complete for working in the factory of the press-maker, as to be erected in the allotted place in a couple of hours, without so much as nail or screw being applied to the building or room, and ready for instant work. The master-printer and the pressmen would be the only agents afterwards necessary, who, without either noise or bustle, would produce a regular supply of Notes, in number as required. Forty shillings a-year would pay all necessary repairs. The type might be weighed daily during the business of composition. The most dangerous process in this respect would be, the stereotyping; but as this, when every thing was complete, would be but the work of a day or two, the precaution of a confidential superintendence would be easily effected. The original, from which all others would be moulded and cast, must be

carefully preserved, together with duplicate casts, by officers of the Bank, under such restrictions as should be most secure and satisfactory.

The circumstances above stated of the great expense, and length of time to be employed before the first One Pound Note, on my plan, could be fabricated, will preclude the possibility of my presenting any perfect copy of what I propose to be the appearance of the Note. The sketch accompanying this will serve to give a general idea of my meaning, where the description has been defective. The type and white stamp are such as may be procured in the ordinary course of business; the medallions were designed and cut without any reference to the present subject, on wood; but they will serve to give an idea of the effect which a proper design, with finer execution, would have for the proposed purpose.

I shall be ready, at all times, to give any further explanation required, and

Remain, Sir,

*A. Aikin, Esq.* &c. &c. &c.

*Secretary, &c. &c.* T. C. Hansard.

## MR. RANSOM'S COMMUNICATION.

71, Judd Place,
April 15, 1818.

SIR;

I REQUEST that you will lay before the Society the inclosed plan, which, in my opinion, will prevent, or at least, greatly diminish the Forgery of Bank Notes.

It consists essentially in a combination of the efforts of men of acknowledged celebrity in the art of engraving, both in the usual mode, and in relief. For this purpose it will be necessary to make use of two steel plates: in one, the letters and ornaments must be in relief, so that they may be printed in the usual manner of letter-press. The other will contain a device composed of engine engraving, and of etching and engraving by eminent artists, the impression of which must be taken off in the common way, by means of a copper-plate rolling press. Thus, the face of the note will exhibit a specimen of high excellence, in each department of the graphic art, and requiring the employment of two plates in its production. The plate containing the designs in relief, must be printed first (if possible, with an ink which will not transfer), by means of that press, whichever it may be, which combines in the highest degree, celerity and exactness. Thus sufficient time will be gained for printing the vignette, &c. contained on the other plate in the most complete and beautiful manner possible.

The subjoined engraving, executed on copper, is a specimen of the vignette, and writing, which would be

# One.

I Promise to pay

or Bearer

the Sum of

[redacted]

Bank of England.

LONDON.

For the Governor & Co of the

Bank of England.

[redacted]

I Will Pay

on Demand.

One Pound.

[redacted]

One

P^r Archer Sculp^r

M^r Lambert Script^et Sculp^r Newcastle upon Tyne

E^t Turrell Sculp^t

contained on the second plate; and I take this opportunity to return my warmest thanks to those gentlemen whose names appear on the plate for the prompt and friendly assistance which they have afforded me. On reviewing my own part of this specimen, I have to regret the inadequacy with which my hand has endeavoured to transfer to the copper, the beautiful design of Mr. Thurston.

I have been induced to offer the above plan, from an ardent wish, that by the immediate introduction of a paper currency more difficult of imitation than the present, the sacrifice of human life may be checked, and that the laborious tradesman may no longer be obliged to bear the heavy losses to which he is now subjected.

I am, Sir,

*A. Aikin, Esq.* &c. &c. &c.

*Secretary, &c. &c.* T. Ransom.

## MR. SOLLY'S COMMUNICATION.

Great Ormond Street,
16th Dec. 1818.

MY DEAR SIR;

HAVING made some experiments for the purpose of ascertaining whether engraving by machinery could be advantageously applied in the manufacture of Bank Notes, I beg leave to submit the result of those experiments to the judgment of the Society.

I have also to submit to the Society a copper-plate printing press, by the use of which the Bank might print their Notes better, and more expeditiously than they can at present, and the persons employed in printing the Bank Notes would avoid the injuries which they frequently sustain by the exertions they are obliged to use in turning the cross.

Should the Society think there is any merit in these communications, much of the credit will be due to others who have kindly given me their assistance, the particulars of which I shall have great pleasure in explaining to the Committee, to whom this subject may be referred. I hope those gentlemen, whose plans for preventing the Forgery of Bank Notes have been already approved of by the Society, will not consider me as their rival, but as being anxious to concur with them in endeavouring to accomplish so important a purpose.

I remain, Sir,

*A. Aikin, Esq.* &c. &c. &c.
*Secretary, &c. &c.* R. H. SOLLY.

*A* Description *of the various Compartments of which the Plate is composed, and of the Difficulties that would be encountered in attempting to imitate the Same, by any other Means than those by which they were executed.*

The description of each compartment will be given separately and unconnected with the rest, because it is not my intention to submit the present plate to the Society as the best model which could be devised for a Note, but as containing specimens of engraving by hand, and by several different machines, all, or any of which, might be made use of, with a view to render the Forgery of Bank Notes, not only more difficult, but considerably more expensive.

The centre compartment, contains a head of Minerva, enclosed in a moulding of concentric ellipses, and encircled by a wreath of oak. For this beautiful specimen of fine art, I am indebted to the kind and able assistance of Mr. Chas. Warren.

Two objections have been made to the introduction of a work of fine art on a Bank Note plate, one of which is, that the public are no judges of fine art, and would not be able to distinguish between a beautiful vignette, and a clumsy imitation of it by an inferior artist. I cannot do better than refer to Mr. Warren's evidence, contained in the Report of the Committee of Polite Arts, for an answer to this objection, by which evidence it appears, that a Bank in the country having had their notes forged, applied to Mr. Warren to engrave a vignette for them, which they made use of both for their notes and bills, during which time, neither of them were forged; they afterwards substituted a cipher for their bills, instead of the vignette, which had not been long in use before it was forged, and they wrote up to Mr. Warren in a great

hurry to engrave a plate for their bills, containing a vignette of fine art. Many of the country bankers employ able artists, at a considerable expense, to make designs, and engrave the plates for their notes, which they would not do, if they did not find the advantage of it. There is this difference between the country bankers and the Bank of England. When a forgery is committed on a country bank, it is obliged to pay the forged Notes, in order to support its credit; but when bank of England Notes are forged, it is the public and not the Bank who are the losers by it. The circulation of the Bank of England Notes is inforced by Act of Parliament. I must admit that the public are no judges of fine art in the sense in which that term is frequently used by connoisseurs, who estimate the value of a work of art solely by its scarcity, or by some arbitrary standard established by the whim or caprice of those who wish to set themselves up as leaders of the public taste. But if a correct representation of nature be essential to fine art, then I think it will be admitted that the public are pretty good judges of the subject. It is no proof of want of taste in a savage, that he admires the rude carving of a face on the handle of a wooden club—he has never seen any thing better; but shew him a good bust, and he will immediately see the difference. Had the people of England never seen any thing better than the engraving of the Britannia on the Bank of England Note, they might, without any impeachment upon their taste, consider it as a most extraordinary specimen of fine art. The vignette upon the Bank of England Note was originally introduced for the purpose of throwing a difficulty in the way of the forger; and, for some time, it probably answered its purpose tolerably well, but the number of persons possessing some degree of skill in the art of engraving has continued to increase, while the merit of the vignette has probably

continued to decrease with each successive copy; even in its present state, I have heard many engravers say, that it afforded them the best means of distinguishing between a genuine and a forged note; the writing engravers would probably be of a different opinion.* Should a work of fine art be introduced, it ought to be a representation of something with which every body is acquainted; as a beautiful female face for instance, or an engraving from one of the fine heads in the British Museum, to which the public have free access. The other objection to the introduction of a work of fine art is, that the Bank could not procure a sufficient supply of able artists to execute the number of plates required for their circulation. The first answer to this objection is, that the Notes might be engraved on steel plates, and if the plates could afterwards be hardened without injuring the work, the Bank could afford to go to a considerable expense in the engraving, as the number of Notes that could be printed from one plate would be almost infinite. But supposing the plates not to be hardened, they would still yield a much greater number of impressions than a copper plate would, and consequently there might be much more time bestowed on engraving each plate. A specimen of engraving from a

* It is only by comparing them together that the public can learn to discover the superior execution of the genuine Notes over the forged ones. The Bank, by the means to which they had recourse, in order to get all the forged Notes into their own possession, effectually prevented the public from making this comparison. In consequence of some legal proceedings the Bank have recently been induced to permit the owners of forged Notes to retain possession of them, having stamped them with the word 'forged.' I think both the Bank and the public are much indebted to those gentlemen by whose firmness in resisting the demands of the Bank, this change in its proceedings was effected. Not only are the public better able to distinguish good Notes from forged ones, but they have also the satisfaction of knowing that all the Notes which are refused payment at the Bank as being forged, are so in reality.

steel plate, decarbonised on the surface, was presented to the Society by Mr. Warren. Steel has also been used in America for the purpose of engraving Bank Notes, and I apprehend that with a little practice Bank Notes might be engraved on steel plates nearly as cheap as on copper. But, should steel not be used for engraving Bank Notes, I still think that a good vignette might be introduced without much more expense than the Britannia costs at present, provided it did not contain a greater quantity of work. The Bank must, of course, go to the expense of getting a good design and a fine engraving, executed in the first instance; from which original all the impressions must be taken for the engravers to copy, and it should be kept for that purpose solely. A copy should never be made from a copy. The Bank must also employ a few good artists to superintend the execution of the rest. I should recommend a vignette of bolder execution than the one on my plate, which is too delicate to stand a sufficient number of impressions, but it may serve as an illustration of the way in which I think a good vignette might easily be executed. If the wreath, the helmet, and the face, for instance, were distributed to as many engravers, and each kept constantly employed on the same part, each would learn to execute his own part with great correctness and dispatch, and a series of nearly fac-similes would be produced; but should one of the engravers be disposed to forge a Note, he would not be able to execute it without the assistance of the rest. I do not think it would be more difficult to make a correct copy of a good engraving than of a bad one; but the same quantity of error which would escape detection in the copy from the bad original would be instantly observed in the copy from the good one. One engraver might copy a piece of hand-ruling done by another, so nearly that it would be almost impossible to tell which was the original and which was the

copy; not that the copy would be a fac-simile of the original, but there being some trifling errors in both, it would require a very minute inspection to distinguish the one from the other; but if an engraver was to attempt to copy by hand, a piece of ruling done by a good machine, the original being perfectly correct, the least error in the copy would be instantly detected. If I am right in the view which I have taken of the subject, a good vignette, or at least, one much better than the present Britannia, might, without difficulty, be introduced on the Bank of England Note, which would be a great assistance to the public in distinguishing between genuine and forged Notes.

Though on this subject, as on many others, I differ in opinion from the Bank Directors, it is but justice to them to state, that I sincerely believe their intentions have been to do that which they thought was most for the public good. I think public bodies should have some regard for the credit of their country. I understand that English art is not much respected on the continent. I hope foreigners do not take the Bank Note for a specimen of English art. But to return to a description of the plate. The vignette is surrounded by a circular band formed by three sets of straight lines; one set consists of radial lines, and the two others of lines terminating at the same point as the radial lines, and forming acute angles with each other, and which would, if produced, be tangents to the same circle. Each set consists of 180 lines. The radial lines intersect the tangent lines precisely in the same points in which the two sets of tangent lines intersect each other, by which means the smallest deviation from the truth would be easily perceived.

The engraving-engine, with which this band, and some other parts of the plate were executed, was made for me by Mr. Allan, and I engraved the band for the purpose of trying the truth of the circular part of the instrument,

which is made on the same principle as Mr. Allan's engine for dividing mathematical instruments, rewarded by the Society with their gold medal, and described in the 28th volume of their Transactions. I do not believe that the most experienced engraver could imitate this part of the specimen by hand, or by any machine in common use, without making such errors as would be immediately perceived. The band already mentioned, is surrounded by one engraved with a rose-engine. An endless variety of patterns might be executed on a similar principle, which it would be extremely difficult to imitate without an expensive instrument of a similar description.

Next to this is a rectangular space of uniform tint, consisting of perfectly parallel and equidistant straight lines, cut with the engraving engine. The writing on this part of the plate was executed by hand in the usual way by Mr. Gullan.

Immediately above the last-mentioned space are two tablets. The right hand one was etched by Mr. Turrell with his ruling machine, the whole being first bit in slightly; the letters were then stopped out with varnish, and the rest bit up to the color required. The left hand tablet is rose-engine work. Corresponding with these, but below the vignette, are also two tablets of which the right-hand one is rose-engine work, and the left-hand one cut with the engraving-engine.

The number of the Note might be printed on the rose-engine tablets.

The tablet on which June 4th, 1818, appears in white letters, was etched by Mr. Archer with his machine for ruling waved lines, and then bit in with aqua fortis, the letters and figures intended to be white being first stopped out.

The tablet on which June 4th, 1818, 1st plate, appears in black letters, was executed for the purpose of ascer-

taining the correctness of my engraving engine. The tint is formed by three sets of straight lines, intersecting each other precisely in the same points, so as to produce a series of equilateral triangles, all of which are precisely of the same size. I do not think this part of the plate could be imitated by hand, or by any other machine at present in use, except that by which Mr. Armstrong engraved his two plates of Mr. Allan's Theodolite for the Society, and which is in this respect similar to mine.

I believe Mr. Armstrong was the first person who applied a machine upon this principle to copper-plate engraving.

Should there be the least irregularity in their width, it would be immediately perceived by the three lines not intersecting precisely in the same point. The screw by which the distance between the lines is regulated, was cut for me by Mr. Allan, who was rewarded by the Society for his mode of cutting a true screw. The instrument he produced to the Society was only calculated to cut a screw of 2 or three inches in length, but he has since made an improvement in it, by which he is able to cut a much longer one; the screw which he cut for me is about 15 inches in length, and the present plate is a severe trial of its correctness. The narrow border which surrounds the writing, was cut with the engraving machine, and consists of lines equal to each other in depth and thickness, placed farther from each other in regular gradation. At right angles to the tablets already described, are two others of close tint, the one engraved and the other etched, in order to show the difference of similar work by an engraving and etching machine. These two tablets were executed by Mr. Turrell and me as a trial of our respective machines. The left-hand one was etched by Mr. Turrell, and the right-hand one is mine. The engraving is on the whole the more even tint, but I do not think there is sufficient difference between them to be easily perceived by a person

not accustomed to examine prints; when the plate begins to wear, I have no doubt the difference will be very perceptible. Mr. Turrell had an accident with the biting, the first time, and was obliged to take it out; he therefore hardly had a fair chance, on account of the difficulty of knocking up a good surface to the copper. These close tints, particularly when etched, will not answer for Bank Notes, on account of the difficulty of printing them; I did not expect they would, but I was persuaded to make the experiment. The upper tablet is cut with the engraving machine, and consists of parallel and equidistant lines, each line being thin in the middle and thickening towards each end by a regular gradation. This might perhaps be imitated by first ruling the lines with an etching machine and then engraving them up by hand; but it would take an expert artist a great deal of time to accomplish it.

The lower tablet is also cut with the engraving machine; the lines are all parallel and equidistant, each line being thicker than the preceding in regular gradation. This might perhaps also be imitated in the same way as the preceding tablet, but not without considerable difficulty. Some trifling errors may be perceived in this tablet, upon a very close examination. The part of the machine upon which its correctness depends, was not in perfect order when it was done. There are still some farther improvements which I propose making to my machine, and when I have made it as complete as I can, no doubt still farther improvements will be suggested by others.

The inside dark border with narrow white lines was etched by Mr. Turrell with his machine, and the outside dark border was engraved with mine; this was also a trial of skill between us and our respective machines. I think upon a close examination, the white lines on the engraved border will appear sharper and of more uniform thickness from one end to the other; but the difference, if

any, is not sufficient to be of practical utility in the prevention of forgery.

I produced the copper-plate to the Committee for the purpose of showing that the outside dark border was engraved with a tool which made the bottom of the lines flat and of equal depth, and therefore capable of affording a cast which might print stereotype, a property not possessed by common engraving or etching, since in both these processes, the lines in the copper are not flat at the bottom. Lines may be cut with this engine to any required width and depth. I am not sufficiently acquainted with the process of stereotyping to judge whether it is capable of taking a cast sufficiently correct to do justice to fine engraving. The corner pieces were etched by Mr. Clement with his machine, for which he was rewarded by the Society with their gold medal, and a particular description of it is given in the present volume of the Transactions. They consist of 1st, a spiral line; 2nd, portions of ovals forming a rose. 3rd, a tint of concentric ovals. 4th, a globe with parallels of longitude.

It was my intention to have filled up the corners with an ornamental pattern, stamped with punches cut for the purpose, but finding considerable difficulty in getting the punches cut to my mind, I availed myself of Mr. Clement's offer, to put in the corner pieces with his machine. I think stamping a pattern with punches might be introduced with advantage on a Bank Note plate, on account of the uniformity that would be produced by it, and the expedition with which it would be executed. I mention this in the hope of inducing others to try the experiment. The exterior border of the plate represents a double linked chain, and was etched by Mr. Clement with his machine; previous to the biting in, the lines were stopped out at the points in which the links intersect each other, and the chain

was afterwards graved up by hand by Mr. Davis; each link consists of five concentric ellipses, and all the links are perfectly similar and equidistant. I conceive it would be impossible, without the use of a similar machine, to make such an imitation of this chain as would not be immediately distinguished from the original. A similar machine could not be procured without a considerable expense, on account of the accurate workmanship required in its construction.

It must occur to every person conversant with the art of engraving, that the time required to grave up the intersections of the links would be an objection to this pattern being used in a Bank Note; but Mr. Clement states, that he could easily make an addition to his machine, by which the point that traces the lines would rise from the plate where the links cross each other, and by that means the labour of stopping out, and subsequent graving up, would be avoided.*

I hope the Society will make an allowance for any imperfections which may appear in this plate, when they

* The figures 4 : 6, which appear in various parts of the plate, indicate the 4th of the 6th month (June).

The date being inserted at length, may be repeated short in various places; hence the forger can only print from one plate, Notes of the same date; for if the date was frequently repeated, by taking it out from all the places, the plate would be so much injured that there would be as much difficulty in repairing it as in engraving a new one. If the issue of Bank Notes of the same date is greater than one plate can furnish, by inscribing each plate 1st, 2nd, &c. the forger is confined within still narrower limits; and as soon as a forged Note comes into the Bank, the farther circulation of the forged Notes from the same plate, may be prevented, by cautioning the public against a forgery of the 4th of June, 1st plate, for instance, pointing out, at the same time, some of the particulars in which the forged Notes differ from the genuine ones of the same date. Thus I think I have shown, that the Bank have it in their power to render it very difficult for the forger to imitate a Bank of England Note plate, and when he had executed the plate, the Bank could prevent his making much use of it.

# JUNE 4TH 1818.

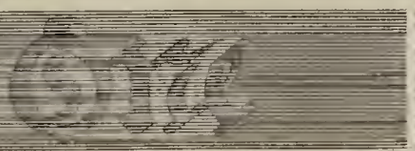
# One

4:6 4:6

An Attempt to prevent

Forgery of Bank Notes.

4:6 4:6



June 4th 1818. 1st Plate.

4:6 4:6
1818 1818

consider that that part of it which was done with the engraving-engine, was executed by myself, and that I had to learn my art as well as to get the tools made, and complete the engine whilst I was engraving the plate.

This engine being made for the common purposes of engraving, has only such movements to it as are usually wanted in copper-plate engraving; had it been intended for Bank Note engraving, it would have been easy to have made such additions to it as would have executed patterns which are not usually wanted in copper-plate engraving, and which, therefore, all persons not employed by the Bank of England might be prohibited from using.* In order to show how well engraving done by this machine will stand, I exhibited to the Committee an impression from a copper-plate, in which the back ground was engraved by this machine, and this part, although very light at first, stood four thousand impressions without any repair, while the other parts of the plate were obliged to be frequently repaired. The tablet of the same plate also engraved by this machine, was originally a little too dark, and after four thousand impressions had been taken off, it still was not become light enough. Any number of plates could be engraved by this machine, so nearly alike as not to be distinguished from each other.

Bank Notes must be printed on hard paper, that the

* It may perhaps be said, that supposing the Bank were to issue such Notes as could not be imitated without the use of expensive and complicated machinery, that although such Notes could not easily be forged in England without detection, they might be forged abroad, and sent over here; and supposing we were at war with France, for instance, the French government might not only connive at, but even advance money to promote the forgery of Bank of England Notes; but it can hardly be supposed that any government would encourage so infamous a crime; and without the connivance of the French government, it would be as difficult to forge the Notes in France as in England.

ink may not run when they are signed; the paper must also be thin: it is the general opinion that a good impression of a fine plate cannot be printed on such paper; in order to try the experiment, I had some impressions of my plate taken off on thin hard paper, and although the impressions were not so fine as those on India or French paper, they were full as good as those on English paper, which is commonly used for book plates in respectable works. One of the impressions on thin hard paper is in the possession of the Society. Mr. Allan also exhibited to the Committee a good impression of delicate machine ruling printed on a Bank of England Note. Indeed I must do the Bank the justice to say, that the paper on which their notes are printed is extremely good of its kind.

I do not believe it to be possible entirely to prevent forgery, but that is no reason why every exertion should not be made to render the imitation of Bank Notes as difficult, and the detection of the forged ones as easy, as possible. The country Banks are as much interested in this question as the Bank of England. The country Banks have lately been but seldom forged upon; because the Bank of England Notes are not only more easily imitated, but on account of their wider circulation, the forgeries of them are more easily passed. Should the Bank of England make their Notes very difficult of imitation, the forgers will then employ their ingenuity in copying the country Bank Notes.—It is hardly to be expected, that any one plan will be successful in checking forgery for any great length of time. Many things can now be easily executed that were very difficult some time ago, and probably many things, which are now considered difficult, will cease to be so at a future time. The Bank must not suppose that they may safely stand still while the rest of the world are going on improving in knowledge and

science; they also must avail themselves of the successive improvements.

It has been stated, that the Society, by giving publicity to the means of checking forgery, will also give publicity to the means of committing the crime, and will consequently do more harm than good.

To this it may be answered, that those who are disposed to commit forgery will easily procure the necessary information without the assistance of the Society. The more the attention of the public is called to the subject, and the more information they have upon it, the more easily will they distinguish between genuine and forged Notes, and the more difficulty will the utterers of forged Notes find in passing them without detection. It is generally supposed that the Bank of Ireland Note is engraved with machinery, and I understand it has been found very effectual in checking forgery. Having had the pleasure of presenting to the Society the instructions published by the Bank of Ireland, to enable people to distinguish between a genuine and a forged Note, together with a proof of the Note itself, I shall here give a copy of the instructions, as I think it will be useful to make them more generally known in England.

"The Notes of the Bank of Ireland, of five pounds and "under, may be easily distinguished from the forgeries "now in circulation, by observing, 1st, the general per- "fection which prevails in the execution of every part of "the Note. 2nd, The extreme regularity and identity "of character prevailing throughout every part of the "border; the scrolls of which it is composed being "without the least perceptible variation. 3rd, The small "black worm lines inserted on the white ground in the "scrolls of the border, which are, as to form, absolute "fac-similes of each other. 4th, The edgings round "the sum, of which the distinguishing characteristics

" are, extreme precision, uniformity and perfect execution.
" 5th, In the vignette, the correct delineation of the crown,
" ribbon, and female figure, and the distinct formation
" of the words, ' Bank of Ireland,' in black, and the
" Latin motto in white letters, which are inserted in the
" ribbon."

The Bank of Ireland communicate to the public the information by which the good Notes may be distinguished from the forged ones, while the Bank of England appears to rely principally upon certain scratches and dots and pecks, and secret marks which can be of no guide to the public so long as they are really kept secret; and being easily imitated by the forger, they only tend to mislead as soon as they become known. I think it probable that the Bank clerks themselves have sometimes been deceived in consequence of the secret marks being imitated in a forged Note.

It will be of no use for the Bank to have their Notes finely engraved, unless they are also well printed.

Mr. Ramshaw's mode of heating the plates by steam instead of a charcoal fire, described in the present volume of the Society's Transactions, is a great improvement in the art of copper-plate printing; by adopting it, the Bank would avoid the danger of fire, the inconvenience from the dust, and the injury to the health of the printers, which arises from the vapor of the charcoal. The Bank should endeavour to make all their Notes as much alike as possible; whereas, by printing what is called firsts and seconds, that is, taking two impressions off the plate each time it is inked, they seem to study to render the impressions, off the same plate, as unlike as possible. Neither of the impressions are good ones; the first being too dark, and the second too light. The printers are frequently strained and seriously injured by the great exertion they are obliged to use in turning the press to

take off the second impression. It is unnecessary for me to enlarge upon this subject, as the particulars were stated to the Commitee by Mr. Restiaux.

The advantages of taking two impressions off the plate for once inking are, that some time, and consequently some expense is saved in the printing, and the plate not being wiped so often, will probably last rather longer.

It may very reasonably be asked how are the Bank printers to produce fine impressions of such plates as the one here submitted to the Society as a specimen, seeing that fine impressions cost much more for the mere labour of printing than common prints do; and this is but just, because there is more time bestowed upon the wiping of the plate when fine impressions are to be taken off, than is done where the number required is considerable, and, consequently, dispatch is the most important consideration. In order to enable the Bank to print their Notes much better than at present, and with the same dispatch, I should propose that a copper-plate press be used for this purpose, of such construction that it may be set in motion by any convenient power, as steam, for instance. The requisites of this press will be understood, by attending to the following considerations: In the first place, it is well known that fine impressions can only be produced by thick ink, and this cannot be forced into the lines engraved on the copper-plate without considerable care and labour. Secondly, the thicker the ink, the more time and labour it requires to wipe the superfluous ink off the plate. Thirdly, when the plate is so prepared, it is absolutely necessary that the pressure of the cylinders should be very great, and the motion slow, that there may be sufficient time for the paper to be driven into the lines engraved on the plate, and thereby receive a fair and perfect impression. If a press was so constructed, that the printer could, by throwing certain parts into gear,

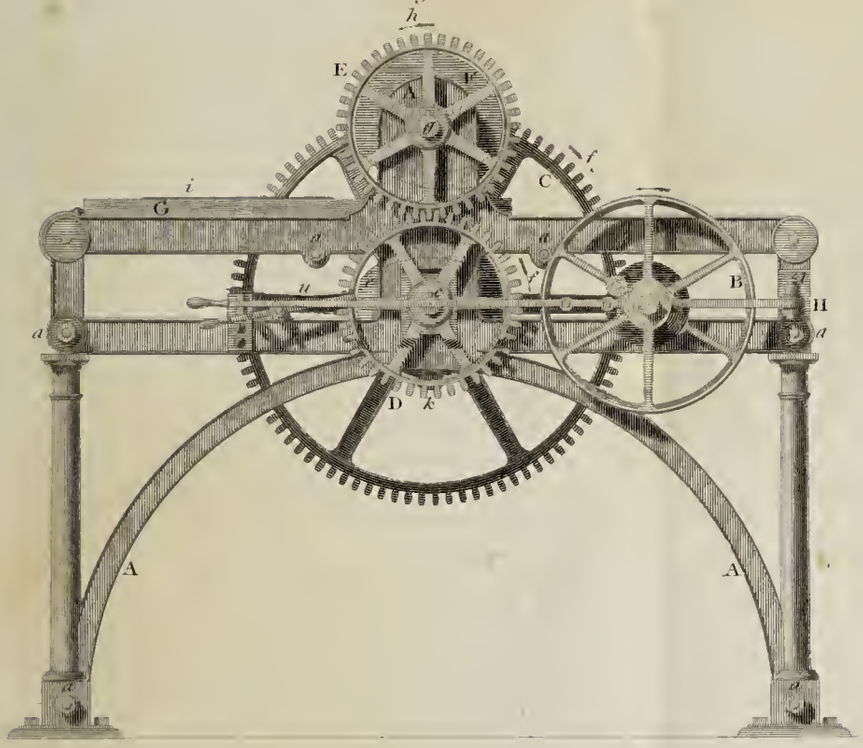
communicate motion to it whenever he pleased, it might be left to complete the operation of taking off the impression, while he was preparing another or second plate; by this means, the time which is now employed by the printer in turning the press, would be saved to him, which time he might be employing in a more careful attention to the inking of the plate. There should likewise be a provision in this press for throwing itself out of gear when the impression is completed, and also for returning the plank of the press to the same position from which it started. By the time this has taken place, the printer will be ready with the second plate, which will now be placed on the plank, and the press being again thrown into gear, the operation will proceed as before. The following engraving and description will show how capable these ideas are of being realized.

Fig. 1, represents a side elevation of the press, the parts of which are as follows :—

A A A represents one side of a cast iron frame, the other side being a duplicate. The two sides are united by six braces, which are made fast by the nuts *a a a a a a*. B represents a wheel which it is intended to set in motion, by a band, in the usual way, the band being passed over a drum, which may receive its motion from a steam-engine, or any other convenient mechanical power. Upon the axis of the band wheel B, is fixed a pinion, which gears into, and gives motion to the great spur wheel C. The great wheel C, is fixed upon one end of the axis *c*. This wheel gives motion to the lower roller *e*, and likewise to the spur wheel D, fixed upon the same axis, both wheels moving in the direction of the darts *f f*. E, represents a similar spur wheel to that shown at D fixed upon the axis *g*, of the upper roller F. The direction of this wheel, when geared into, and set in motion by the wheel D, is shewn by the dart *h*. G, represents the side or

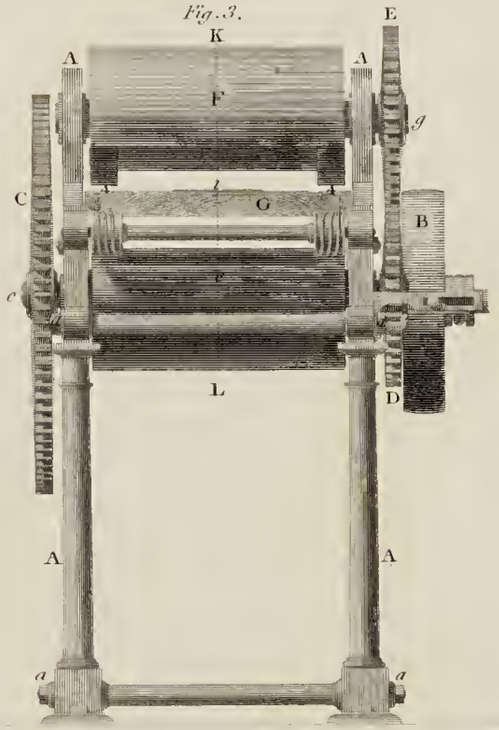
*Side Elevation.*

*Fig. 1.*



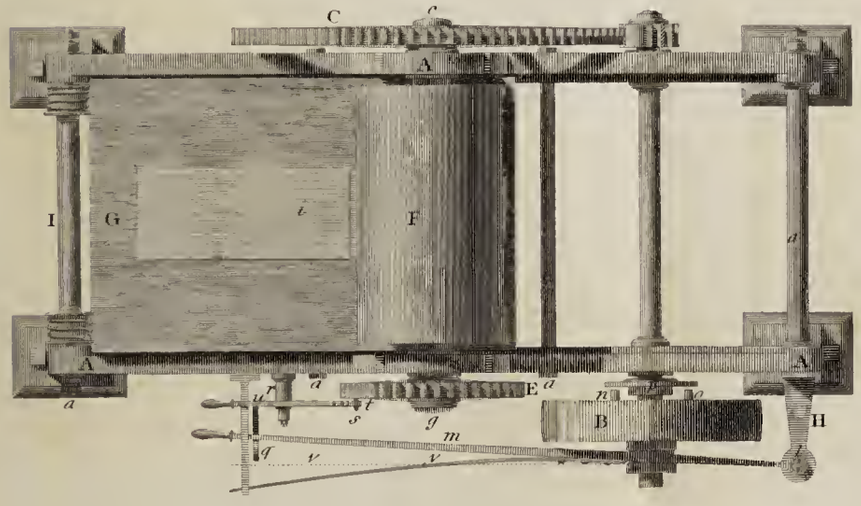

*End Elevation.*

*Fig. 3.*



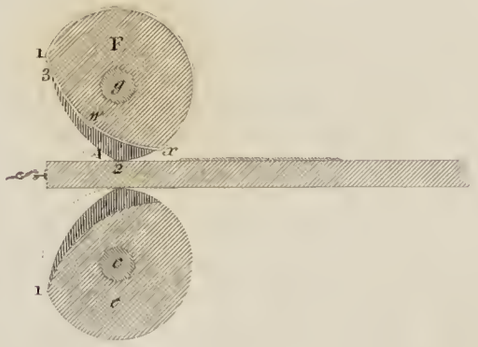

*Plan*

*Fig. 2.*




*Section of the Rollers and Table.*

*Fig. 4.*



Drawn by J. Clement.

# Improved Copper Plate Printing Press for Bank Notes.

Engraved by Edmd. Turrell.

edge view of the mahogany plank, upon which is laid the copper-plate *i*. In the usual manner, the screw, shown at *k*, is used to elevate or depress the lower roller *e*, so as to increase or diminish the pressure upon the copper-plate, as occasion may require. To effect this in the best manner, the axis *c*, is made to work at each end in brasses, the brasses moving in mortises formed for that purpose in the cast iron frame. It may be necessary to observe, that there is a similar screw to that shown at *k*, on the other side of the press, used for the same purpose, namely, that of elevating or depressing the axis *c*. The further explanation will be greatly assisted by referring to fig. 2.

Fig. 2, represents a plan of fig. 1, the same letters of reference being used upon the same parts, wherever they can be seen. H represents a projecting arm that has the centre pin *l*, fixed at its end, upon which the lever *m*, moves. This is used to move the band wheel B, upon its axis, until the two fixed pins *n* and *o*, fall into gear with the coupling box P; and when the wheel is so placed in gear, it is kept in that position by the catch-piece *q*, holding the end of the lever *m*. The catch-piece *q*, swings on the fixed pin or axis *r*, and continues to hold the lever *m*, in the position here shewn by the action of the spring *u*, until the copper-plate has been completely passed through or between the rollers and a little more; when, at that moment, a pin *s*, fixed on the circumference of the wheel D, elevates the end *t*, of the catch-piece *r*, and depresses the catch *q*; by which means the lever *m*, is released and forced back to the position shewn by the dotted line *v*. This is effected by the action of the spring fixed to the lever *m*, shown at *y*, which of course draws the band wheel B, and its two pins out of gear, and the moving parts of the press instantly become stationary. The catch-piece *q*, is again

brought to its original position, and fit to receive the end of the lever *m*, by the spring *u*, before named : the position of this may be better seen at *u*, fig. 1. I, represents an axis, at each end of which is formed a cylindrical box, or barrel, containing a spiral spring : each of these barrels has a cord coiled round it, one end of which is made fast to the barrel, and the other end is furnished with a hook, which is placed in a staple fixed at each end of the plank G. By these springs being in a state of tension, the plank G, is kept in the position here shown ; but when the press is set in motion, the rollers force the plank and plate to move forward, which uncoils the cord, and winds up the springs contained in the barrels, by which means, when the rollers disengage the plank, the force of the springs is applied to coil up the cord, and thereby return the plank to the position here shown.

Fig. 3, represents an end view of the press, in which the action of the rollers, and the peculiar shape of each will be better seen ; but, for the purpose of elucidating the operation more clearly, a section of the rollers and plank is given in fig. 4, the section being taken through the line K L of fig. 3.

Fig. 4, represents a section of the rollers and plank after they have carried the plank forward, and are about to be disengaged from it ; this is effected by the peculiar shape of the rollers, which I shall now endeavour to explain. F, represents a section of the upper roller, the external surface of which is an uniform cylinder, from 1 to 2. The remaining portion of the cylinder is removed so as to leave a surface as represented by the line 3 4. After this is done a second portion is cut away, leaving at each end the projections seen better at 4 4, in fig. 3, both rollers being the same, their shapes appear similar, except that in this figure the upper roller is represented with a blanket placed round it, which is fastened with pins in

the usual way in the recess formed in the roller. This is shewn by the overlap of the blanket at *w*.

When the rollers are set in motion, the parts 1 and 1 come in contact with the plank, the one above, and the other below, and, by their motion, carry the plank forward, and with it the copper-plate, upon which the paper is laid in the usual manner. This motion is continued until the copper-plate is completely clear of the upper roller, which, however, still continues to carry forward the plank until the edge formed by the intersection of the two curves at *x* is sufficiently raised to let the copper-plate pass freely under it, which it does, as the rollers proceed on in their revolution, for they then disengage the plank, and permit the spiral springs contained in the barrels to return the plank to the position from which it started.

It is but justice to Mr. Clement, to state, that it is principally through his assistance I have been enabled to complete these improvements in the copper-plate printing press. Should the Society think this press worthy of publication, I will have the drawing engraved, and present the Society with as many impressions as they may require for that purpose. I shall also have great pleasure in presenting them with impressions from my plate, engraved principally by machinery, to accompany their report on the best means of checking the forgery of Bank Notes.

*P. S.* I am afraid the close tint, etched by Mr. Turrell, with his machine (*see* p. 48), will not stand the number of impressions required for the publication; in that case, I must be under the necessity of having it taken out, and requesting Mr. Turrell to put in something else in the same place that will stand better, and not be so difficult to print.

## *Mr. Williamson's Description of his two Steel Plates.*

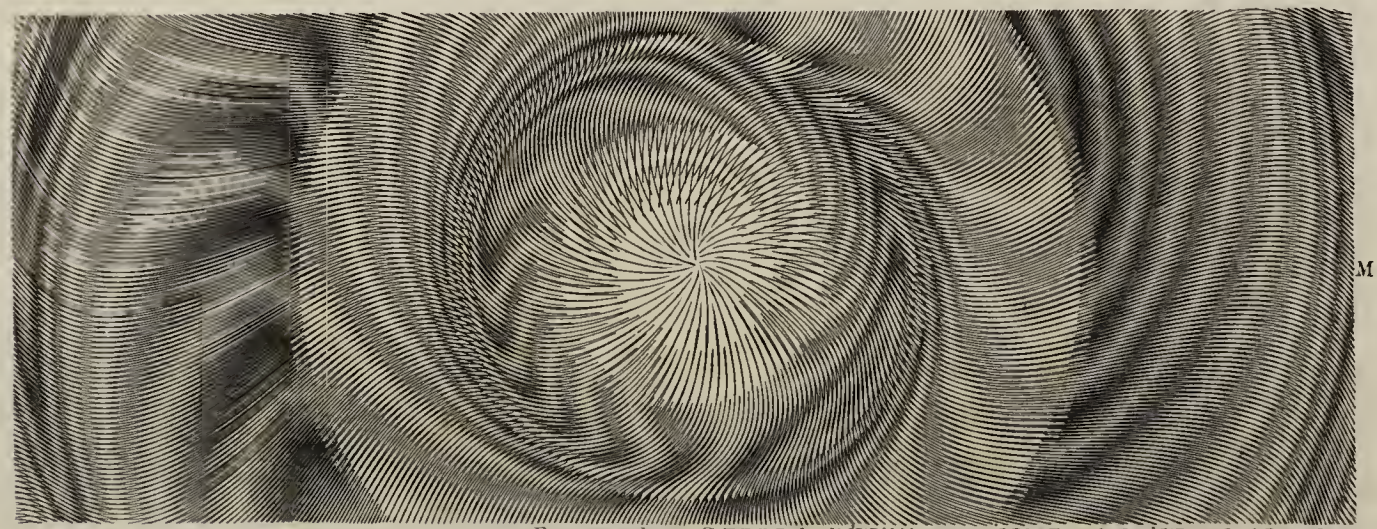
8, Brook Street, West Square,
7th April, 1819.

SIR;

THE Society of Arts having kindly consented to print, and the Committee, to whom it was referred, having selected two steel plates of mine to be introduced with other specimens in their Report as to the best means for the Prevention of Forging Bank Notes, I should be particularly obliged by an introduction of this letter, which will, perhaps, be sufficiently illustrative, without going into abstract matter. As the subject has long occupied my attention, so I trust the specimens selected by the Committee on the 5th instant will prove that they are not the produce or works of chance, as has been repeatedly asserted; to which, I can only add, I am ready to engrave again any pattern offered by me to the consideration of the Society. The impressions will show that the steel plates are firm, bold, and clear, yet delicately engraved; so likewise are the copper plates; in proof, I beg leave to refer you to an impression taken after 12,000 copies had been struck off from a plate engraved by me in sixteen hours, for the back of a note of the Monmouth Bank, with cypher B., S., and Co.; and it is clear, that with less than half an hour's work, it would print 8 or 10,000 in addition to the 12,000 already taken off. The steel plates being so much harder, will assuredly stand 100,000 copies at least, as they are engraved deep, and do not require half the wiping to clean the surface that copper plates do; this is a very considerable advantage which steel plates possess over copper plates; at the same time, the steel plates,

from being closer metal, and a finer surface, produce a more brilliant impression; thus much I can state, having printed myself every impression that has been taken from any plate of mine; nor did any one see or know any thing of the steel plates engraved by me, excepting my own family, till I submitted them to the inspection of Mr. Barber Beaumont, a few days prior to his communication to the Society. In the specimens, the plate marked M is intended for the signature of the note; the plate marked N 1 is intended for the back of notes. I hope and trust the indefatigable exertions of the Society in exploring and bringing forward every thing that study, talent, or invention, could produce, will receive the highest encomiums and gratitude from their country. With every respect,

I remain,
Sir,
&c. &c.
RICHARD WILLIAMSON.



M

Engraved on STEEL, by R.d Williamson, N.o 8, Brook Str.t West Sq.e London.

For the Signature of Notes.

N 1.

*This Specimen of Engraving on STEEL, by R.d Williamson, 8 Brook Str.t West Sq.e London.*

*For the back of Notes.*

*Addition to Mr. Ranson's* Communication.*

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31, Judd Place West, New Road,
April 10th, 1819.

SIR;

On looking into the Report of the Society of Arts, &c., respecting the forging of Bank Notes, I find that part of my communication of the 15th of April, 1818, has been omitted. In consequence, I beg leave most respectfully to offer the following additions:—The *letters and ellipses* should be cut and left standing in relievo; and by this method the plate may be stereotyped almost for ever, and by producing an incalculable number of *fac similes*, will be of the utmost importance.

I have the honour to be,
Sir,
&c. &c.
Thomas F. Ranson.

* In pp. 38 and 39 the name has been erroneously spelt Ransom.

# MINUTES OF EVIDENCE.

## *April* 15, 1818.

Read Mr. J. T. B. Beaumont's communication.

Mr. *Charles Heath* presented to the Committee specimens of American Bank Notes, Nos. 2, 3, 4, 5, which in his opinion cannot be forged. The present Bank of England Notes, he considers as very easy of imitation.

Mr. *Ashby* stated, that Bank Notes are in his opinion easy of imitation. He has been upwards of 20 years in business, during which time he has been largely employed in engraving Country Bank Notes. Those into which he has introduced important vignettes, have never to his knowledge been forged.—Several Yorkshire Banks were forged on in the course of last year, but the Notes of all these Banks were engraved in a very inferior manner. Superiority of execution is in his opinion the only effectual method of preventing forgery, and so far he concurs with Mr. B. Beaumont's plan.

Mr. *Williamson* considers Bank of England Notes easy of imitation. He objects to introducing vignettes into a Bank Note, because as they cannot be made an essential part of the Note, it would be easy by blotting ink on the vignette so to deface it, as to render it impossible to distinguish the genuine from the spurious Note, and yet if the other part were entire, the Note would continue to circulate. Mr. W. gave in some

specimens of engine work printed with a different coloured ink from the rest of the Note, according to a plan invented by him, and which has been adopted by Banks at Bath and at Waterford during the last 16 months with complete success, no forgery having as yet been practised on them.

Mr. *Ramshaw* stated, that he was employed to prove a steel plate engraved for Mr. Dyer, in imitation of the American. It weighed 56 lbs., and was more than an inch in thickness. It required a peculiar press; but Mr. R. is of opinion that men who were accustomed to the use of that press, would perform more work than with the common press.

Mr. *Warren* stated, that Bank of England Notes are very easy of imitation, forgeries being generally committed by persons acquainted only with the very rudiments of the art of engraving. He is persuaded, that Bank Notes might be made almost impossible to be copied, by the union of high talent in two or three departments, viz. by combining fine vignettes with intricate engine work. The expense of executing a plate in this style, would no doubt be more costly than where the common work is had recourse to; but this increase of expense would be more than counterbalanced by substituting steel for copper, in consequence of the durability of the former being more than ten times as great as of the latter. From his own experiments he is convinced that softened steel may be cut very nearly as easily as copper. About 7,000 copies are taken by the Bank of England before the copper plates used by them require to be retouched, but he is informed, from good authority, that a steel plate would furnish 100,000 copies without requiring repair. He is of opinion that an able artist might make a perfect *fac simile* of his own work, but not of a capital production by another artist.

Mr. *Pye* stated, from his own experience, that etching and engraving on blocks of softened steel, may be done with as much ease as on copper; and the block when hardened, will, in his opinion, furnish a vast multitude of impressions. He also states, that a steel block after having been hardened, may be again softened and repaired, and afterwards a second time hardened. He has seen forged assignats, notwithstanding that many various kinds of engraving and printing were employed on them.

Mr. *Gill* stated, that steel blocks for engraving Notes, may be a second time softened and hardened without difficulty.

Mr. *Silvester* stated, that he has engraved plates for nearly 100 Banks. From 5,000 to 6,000 copies are generally taken from one copper plate. He does not consider the Bank of England Notes as very easy of imitation, but is persuaded that they might be made much more difficult of imitation by employing better artists. Those Country Banks that have chosen to go to the expense of good vignettes, have never been forged upon as far as his experience goes.

Mr. *White* considers Bank of England Notes to be not at all difficult of imitation. He formerly sent into the Bank of England a plan similar to that of Mr. Beaumont, but upon a different principle of execution. Is most fully convinced, that in order to meet every requisition for the purpose of preventing forgeries, and giving facilities of execution requisite to the large diurnal demand of the Bank of England, copper plate engraving as a system, and especially exquisite historical work, appears the most unlikely means of effecting the desired end, and is liable to insurmountable objections.

*April* 18.

Mr. *T. C. Hansard* stated, from information on which he can rely, that the American Notes executed by Murray, Draper, Fairman and Co., of Philadelphia, are erroneously supposed to be printed directly from steel plates. The manner of the engraving of the ends of the Notes, and the small Medallions indicative of the number of dollars, plainly indicate a different process from ordinary plate engraving: the impression of those parts must necessarily have been given by the surface of the plate, not by the bottom of the lines. The following is the process: The engraving is cut and punched on steel plates, or blocks previously softened, and afterwards hardened again. These plates are then passed repeatedly between cylinders of soft steel, which latter thus receive the impression in reverse of the plates.*

Mr. *Engleheart* stated, that Bank of England Notes are easily forged; that comparatively few forgeries take place on Country Notes, in consequence as he apprehends of the superior execution of these latter.

Mr. *Ranson* stated, that the Bank of England Notes are very easy of imitation, that the impression of a Note may easily be transferred to the surface of a copper plate by means of wax. He thinks Mr. B. Beaumont's plan too complicated, and on this account not likely to be adopted by the Bank of England.

Mr. *Ramshaw* stated, that he has heard from good authority, that the daily issue of Bank of England Notes of all

* Farther details on this subject are contained in Mr. Clymer's evidence, May 15.—(*See* p. 68.)

descriptions, is about 60,000; in producing which, about 53 pressmen are employed.

Mr. *Warren* stated, that the steel plate proved by Mr. Ramshaw was not hardened. He presented, 1st, a specimen of the first vignette executed by him for the Plymouth Bank, and which has never been forged; 2nd, a specimen of the cypher used by them, which has been forged; 3rd, a specimen of another vignette executed by himself to replace the cypher, and which has not hitherto been forged.

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*April 25.*

Read Mr. T. C. Hansard's communication.

[In answer to questions from the Chair, Mr. Hansard stated, that it would be very easy for the Bank to introduce private marks in the proposed Note, by slight variations in one or more of the letters of the words printed in diamond type, by the combination of which words, the large letters are formed. Of the letters in diamond type 5,000 or 6,000, would be employed in each note. The time required by the best artist in cutting the punches for the matrices of this diamond type, would be from 6 to 9 months. The cost of the whole apparatus as far as the printing is concerned, presses included, would be from 500*l.* to 1,000*l.* The cost of the Notes, including paper, would probably not exceed 20*s.* per 1,000.] Mr. Hansard produced specimens of stereotype diamond type, and of paper capable of furnishing 24 Notes per sheet.

Mr. Hansard being asked whether it would be possible for the 12 or more artists required to produce a Note on his plan, to make a *fac simile* of the same, replied, that he thought it was impossible. It is no easy matter for one artist to copy

his own work without alteration, and that twelve or more in such different lines of work should concur with perfect success is almost impossible.

Mr. *B. Beaumont* stated, that subjects composed of diamond type have already been before the Bank Directors.

Instead of employing the diamond type in composing large letters on Mr. Hansard's plan, Mr. B. proposed to introduce along the top of a Bank Note, as many different alphabets in the smallest type as could be compressed into one line; to repeat such line eight or ten times, one closely under the other; thus the greatest variety of punches would be required, and by placing eight or ten specimens of each punch in a row, in immediate comparison, imitation by engraving would be prevented, as the engraver could not make every letter so exactly alike as to appear to come from one punch.

Mr. *Turrell* stated, that the writing of the present Bank Note is very well engraved, and that in his opinion, a writing engraver would not be able to imitate one till he had been at least a year in the practice of his art; he has seen writing engravers pupils occupied for a whole week in copying one letter, and at the end of that time have been very far from perfectly succeeding. A *fac simile* might, in his opinion, be made of any mode of engraving, with a difficulty proportioned to the skill of the artist, and the style of the work to be copied. By pencilling over a Note, and then taking a copy of it, even the best engraving might be imitated by a skilful artist, so as to deceive ordinary observers. Of writing engravers there are several classes; some confine themselves to german text, some to stump hand, &c., and some are general engravers. Every writing engraver who can execute a good card, may imitate a Bank Note.

The plan proposed by Mr. Hansard would be peculiarly difficult of imitation in copper. All that part of Mr. Hansard's Note, which is in stereotype, must be imitated by cutting protruding characters on the copper; a process so unusual and so difficult that hardly one person could be found capable of executing it, where 500 might be found able to imitate the present Bank Note. To imitate throughout on copper the Note proposed by Mr. Hansard would require the practice of a life.—The only other way of copying Mr. Hansard's Note would be by wood engraving, but this method of cutting cannot represent the sharpness of the punch used in making types. He prefers the stereotype to copper-plate engraving as requiring the combination of a greater number of artists. Another advantage in stereotype is the greater facility in printing from it than from copper. The work of all engraving machines might he thinks be imitated by hand so as to deceive most of those into whose hands Bank Notes fall, except in the case of large tints. And it is his opinion, that any imitation of type printing by means of copper-plate would be easily detected, because the type gives an indented impression, and copper-plate exactly the reverse; all the lines in the latter mode being raised above the surface of the paper, while that printed from type is considerably indented. The consequence is, a very material difference in their general appearance.

Mr. *Gill* presented a specimen of paper in which the water mark is more opaque than the ground.

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*May 2.*

Mr. *Turrell,* in addition to his former statement, said, that Bank of England Notes are not at present forged by writing

engravers or their apprentices, but by persons at Birmingham, Manchester, and other places, who have probably been long engaged in engraving for the calico printers. With regard to the 15 dollar American Bank Note, which contained many words engraved in very small characters scattered over its surface, he stated, that the engraver of the Bank of England was three months in imitating one-fourth part of it.

Mr. *Lee* was of opinion that it might be *possible* to imitate Mr. Hansard's plan on blocks of wood or brass, cut in relief (inasmuch as he conceives nothing can be done which may not be imitated), but that such immense time and patience would be required as to preclude all probability that it would ever be attempted, and consequently that it is as complete, as it respects forgery, as if it was actually impracticable.

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*May* 8.

A letter from Mr. Bessemer, addressed to Mr. B. Beaumont, states, that the time required to engrave a diamond lower case alphabet and doubles, consisting of 33 punches, would be about 6 weeks; and that the same time would be required for a set of capitals of 28 punches. On which Mr. T. C. Hansard observed in reply, that the number of punches required in Mr. H.'s proposed Bank Note was 157, and therefore, on Mr. Bessemer's own calculation would take 32 weeks to cut. But if an individual were to attempt to complete a fount of letter by himself from first to last, it would occupy him several years.

Mr. *Caslon*, letter-founder, stated, that the punches of the diamond type cast by him were cut by Mr. Bessemer, and that for this fount of type at least 150 punches must have

been cut, as every separate letter and character requires a separate punch. He thinks that it would be scarcely possible for one person to complete a fount of letters from first to last. In the ordinary course of business the mere preparation of the types after the punch cutter has finished his process, goes through the following eight different hands; 1st, the justifier, who strikes the matrices; 2nd, the mould maker; 3rd, the caster; 4th, the breaker off; 5th, the rubber; 6th, the kerner; 7th, the setter up; 8th, the dresser. Two of these are boys; and although the work might no doubt be executed by fewer than eight different hands (this particular number being however adopted as most conducive to expedition and excellence of work); yet that the whole could be gone through by one person he thinks barely and scarcely possible, he has himself never heard of an instance of such having been the case. If only one person was employed in each department, a fount of types could scarcely be completed in 7 or 8 months; at present there are only 4 or 5 persons in England who can execute diamond type, owing no doubt to the limited demand for it; and the peculiar style of each of these punch cutters is perfectly well known to persons conversant with letter founding.

The large type figures in the present Bank of England Notes were cast by Mr. Caslon. The Bank retain the matrices in their own possession, from which they have types cast by Mr. Caslon when they want them.

It would take a person a day to cut two punches of diamond type, and in his opinion Mr. Bessemer could not get ready for the founder a complete fount of diamond type in less than 4 or 5 months; and to get the types from the punches ready for use would occupy 6 or 8 months longer.

*May* 15.

Mr. *Clymer* of America, whom the Secretary had been ordered on a former night to invite, being present, stated from his own personal knowledge, that the engraving of the ornamental borders of the American Bank Notes is made on thick plates of soft steel, the circular work being put in by the lathe, and the flowers and other ornaments by punches, and the methods commonly practised by the die engravers. After the pattern has been completed the plates are hardened. These plates are then employed, to impress a reverse on rollers of very soft cast steel, by repeatedly passing the plate between the rollers. The rollers are then hardened, and from these the impression is transferred to plates of copper, on which the writing and vignette are afterwards engraved in the usual way. Each plate contains 4 notes. Mr. Clymer stated, that he was one of a company in the United States during the late war, whose object was, to produce Notes as difficult as possible of imitation. For this purpose they formed the borders of impressions from block cutting on brass, and the body of the Note was filled up with type. Some of the Banks adopted their Notes, but peace coming on, the company broke up, after having subsisted only a few months, and the plan was not pushed to any extent; 1, 2, and 3 dollar Notes were all that were made, and these are still in circulation. He has known forgeries to have been committed on those American Banks whose Notes were executed by Murray and Co. where they have been for considerable sums, but not for 1, 2, or 3 dollars. A regular establishment for forging the American Notes was formed in Canada during the war.

*December 22.*

Mr. Solly's communication was read and taken into consideration.

Mr. *Turrell* expressed his conviction, that the engine-work in Mr. Solly's specimen, cannot be adequately executed by hand, and that it offers as complete a prevention of forgery as can be effected by copper-plate engraving. He is of opinion, however, that type printing offers on the whole the most perfect security.

Mr. *Ramshaw* observed, that the time required for inking a plate is according to the fineness of the work which it contains; and comparing the work of Mr. Solly's specimen with that of the ordinary Bank-Note, is persuaded that the time required for inking the former so as to do justice to it, would be four times that required for the latter.

A doubt having been expressed whether fine work could be taken off on hard or sized paper, Mr. *Restiaux* stated, that he had taken off good impressions of some of Bartolozzi's fine engravings on hard paper; and Mr. Allan exhibited specimens of engraving performed by his engine, taken off on the back of a Bank-Note.

Mr. *Restiaux* stated, with reference to Mr. Solly's proposed press, that in the Bank they print two impressions from one inking; the first impression requires no great bodily exertion, but in order to get off the second, a pasteboard is thrust below the plate, in consequence of which an enormous strain is required. The price paid at present by the Bank for printing, is 7*s.* 6*d.* per ream of 480 double Notes; whereas,

if the plate were inked every time, the cost would be 10*s.* 6*d.*; the difference between these two sums is the saving to the Bank.

In printing coarse work the times of inking and of passing through the press are nearly equal; by saving the latter, therefore, half the workman's time is saved; but in proportion to the fineness of the work is the time required for inking, whereas that for passing through the press is nearly the same for coarse as for fine work. Therefore, as the engraving on the Bank-Note becomes of higher quality, the advantage of Mr. Solly's press, as far as the saving of time is concerned, will be diminished.

Printed by T. C. Hansard, Peterborough-court, Fleet-street, London.

HONI SOIT QUI MAL Y PENSE